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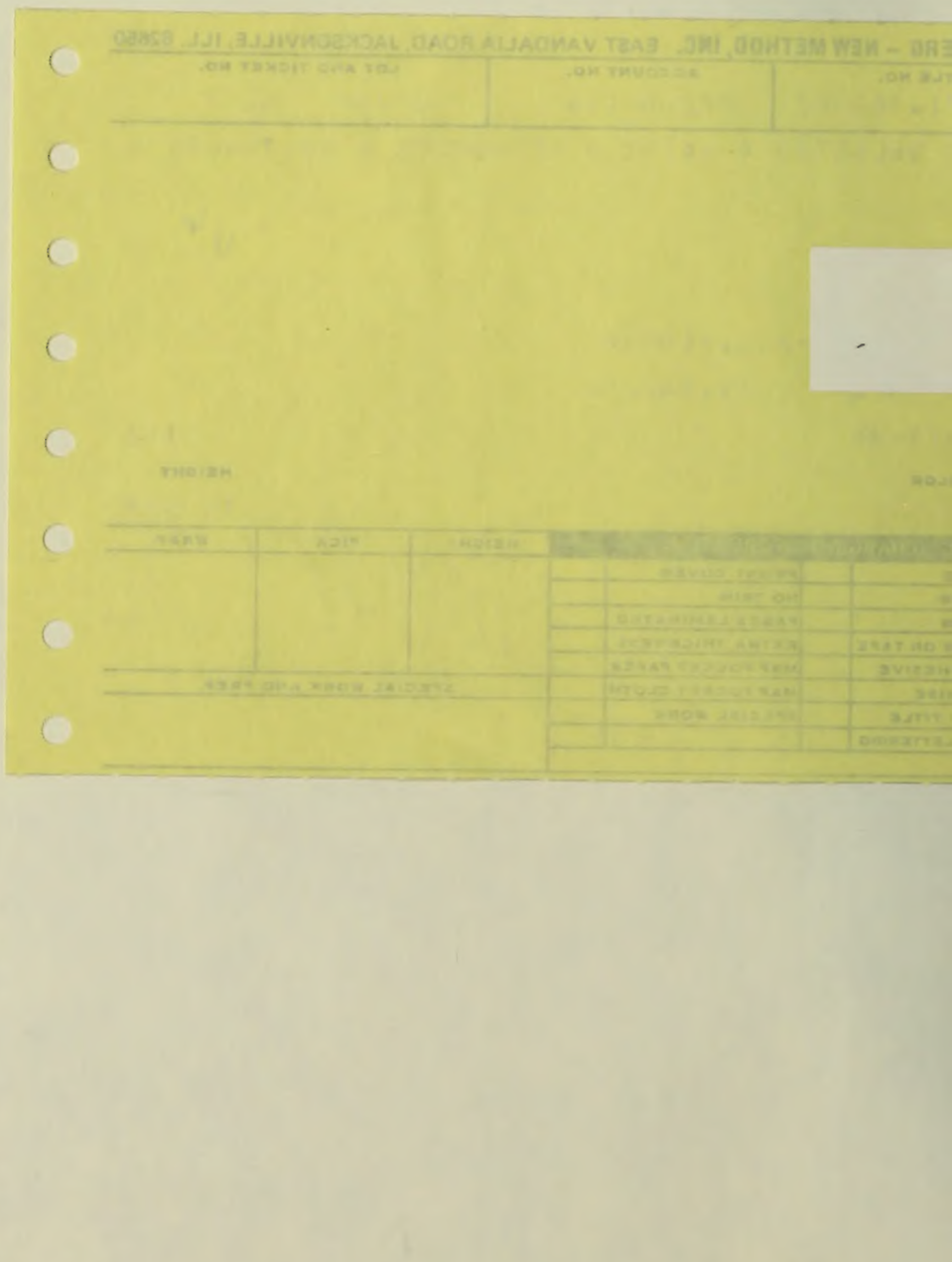

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 5
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 16, NUMBER 5
MAY 1983

W83-01401 -- W83-01750

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Directory of the Office of Management and Budget through September 30, 1983.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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U.S. Geological Survey, MS 421
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

ATOM PAIR DISTRIBUTION FUNCTIONS OF LIQUID WATER AT 25C FROM NEUTRON DIFFRACTION,
Oak Ridge National Lab., TN.
A. H. Narten, W. E. Thiessen, and L. Blum.
Science, Vol 217, No 4564, p 1033-1034, September 10, 1982. 2 Fig, 9 Ref.

Descriptors: *Physical properties, *Water properties, *Molecular structure, Neutron diffraction, Atom pair distribution.

The three-atom pair distribution functions which describe the structure of liquid water were derived from neutron diffraction data on four mixtures of light and heavy water. The function g00 (r) derived from neutron data is not significantly different from that obtained by X-ray diffraction. It concerns the positional correlation between centers of molecules in liquid water. The nearest neighbors are asymmetrically distributed, centered at 2.85 A, which overlaps with the distribution of tetrahedrally coordinated second neighbors near 4.5 A. The function, gHH(r), describing the distance distribution between H atom pairs (orientation correlations in the liquid) features near neighbor distribution centered at 2.29 A, overlapping the distribution of second neighbors near 3.9 A. The function, gOH(r), shows a narrow distribution of first neighbors near 3.2 A. These results will be useful in efforts to produce a realistic statistical mechanical theory of liquid water. (Cassar-FRC)
W83-01483

2. WATER CYCLE

2A. General

THE LOCH EIL PROJECT: SIMULATION OF THE HYDROLOGY AND SEDIMENT INPUTS TO LOCH EIL,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
G. Fleming, and R. A. Walker.
Journal of Experimental Marine Biology and Ecology, Vol 55, No 1, p 103-113, 1981. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Rainfall-runoff relationships, *Erosion, *Sediment yield, Hydrologic models, Model studies, Strathclyde Sediment Model I, Soil erosion, Loch Eil, *Scotland, Sedimentation, Catchments, Rainfall intensity, Fjords.

A simulation of the water and sediment response of the Loch Eil catchment, using the Strathclyde Sediment Model I, provided only a rough approximation of observed sedimentation in the Loch. Annual sediment yields predicted from 4 series of precipitation records were 17, 125, 158, and 223 tons per sq km. For this basin few measurements for rainfall, runoff, and sediment yield were available. Therefore, data for nearby or similar watersheds were used as model inputs. The influence of rainfall intensity on the prediction of erosion for the catchment was a critical factor. The model correctly predicted net erosion from the three segments: upland, midland, and lowland. There was no marked difference in soil size distribution among the three sections. (Cassar-FRC)
W83-01441

INFILTRATION MODEL IN SIMULATED HYDROGRAPHS,
Technische Univ., Dresden (German D.R). Bereich Hydrologie and Meteorologie.
For primary bibliographic entry see Field 2G.
W83-01472

ISOLATING THE RANDOM RAINSTORM COMPONENT FROM BASIN RESPONSE FACTORS IN RAINFALL-RUNOFF DATA,
Oklahoma Univ., Norman. Dept. of Geography.
J. M. Harlin.
Water Resources Bulletin, Vol 18, No 4, p 649-653, August, 1982. 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall-runoff relationships, *Hydrographs, *Watershed studies, *Storms, Geomorphology, Little Washita River, Factor analysis, Mathematical studies, *Oklahoma.

The potential for eigenvalue-eigenvector analysis was demonstrated in delimiting th spatial relationships between raingages positioned throughout a basin and discharge near the mouth of a stream in a manner that is both economical and transferable. The study focused on the Little Washita River, a tributary subbasin of the Southern Plains Research Watershed. The Little Washita watershed encloses 246 square miles, and rainfall is monitored by 33 raingages. Correlations between raingages distributed throughout the basin and stream discharge are influenced by both storm patterns and drainage basin characteristics. Factor analysis applied to rainfall-runoff relationships isolated the storm pattern from a basin response factor. Comparing two periods of time separated by 8 years revealed relative stability in the rainfall attenuation (basin response) factor, while storm patterns for the two periods of record were quite disparate. (Baker-FRC)
W83-01480

URBAN RAINFALL-RUNOFF-QUALITY DATA BASE,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 7C.
W83-01569

MODEL FOR SIMULATING RUNOFF AND EROSION IN UNGAGED WATERSHEDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W83-01604

AN ASSESSMENT OF THE PERFORMANCE OF FEDERALLY REGULATED SEDIMENTATION PONDS,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 5G.
W83-01610

SIMULATION OF THE REVEGETATION POTENTIAL OF COAL MINES IN SEMI-ARID CLIMATES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 2I.
W83-01611

DEVELOPING A NEW DECONVOLUTION TECHNIQUE TO MODEL RAINFALL-RUNOFF IN ARID ENVIRONMENTS,
Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 7C.
W83-01627

ROLE OF INFILTRATION IN STORM WATER MANAGEMENT,
Kansas Water Research Inst., Manhattan.
J. S. McNown, and G. T. Spehar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150383, Price codes: A02 in paper copy, A01 in microfiche. Contribution No 222, December 1981. 20 p, 11 Fig, 4 Ref. OWRT A-095-KAN(1), 14-34-001-9018.

Descriptors: *Infiltration, *Storm runoff, *Urban hydrology, *Rainfall-runoff relationships, Hydrologic models, Computer models, Urban runoff, Soil saturation, Paving.

Runoff from storm drainage systems is affected by the rapid decreases in rates of infiltration which usually occur during periods immediately after rainfall begins. This reduction affects the volumes of runoff and maximum rates of discharge in ways that vary with the rate of decrease and the length of the storm. A linear reduction in the rate of infiltration from the assumed rate of rainfall to a constant rate for saturated soil is a useful approximation to the actual accurrence and to the commonly used Horton exponential curve. The effect of the various parameters of infiltration have been determined by means of calculation of runoff from two urban blocks (about 7 acres). All studies were made for a 25 year return period, for blocks 300 ft x 500 ft arranged with the land draining toward the street from the centerline of each block. A computer program served to calculate hydrographs from assumed conditions for flow from previous areas, from impervious parts of lots in a developed area and in paved areas. The results provide estimates of the magnitudes of delays and reductions in runoff caused by varying patterns of infiltration. (Moore-SRC)
W83-01634

THE USE OF FLOOD POTENTIAL INDICES FOR FLOOD PEAK ESTIMATION ON UNGAGED WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, D. F. Kibler, and C. J. Tagliati.
Water Resources Bulletin, Vol 17, No 4, p 691-698, August, 1981. 5 Fig, 1 Tab, 10 Ref. OWRT A-049-PA(5), 14-34-0001-8040.

Descriptors: *Flood peak, *Estimating equations, Flood hydrographs, Flood protection, Flood control, *Flood forecasting, Watersheds, Watershed management, Mapping, Maps, Ungaged watersheds.

An attempt was made to construct a flood peak index map for use by hydrologists in the simple format of rainfall maps. The effect of area was removed from consideration, as flood peaks are highly dependent on watershed area. Flood peaks of 2.33 and 100 year return periods were found by regression analysis to be proportional to watershed area to the 0.8 and 0.7 powers, respectively. Attempts were made to remove more of the scatter by regression of the indices C with several other watershed parameters such as slope, percent forest cover, and watershed shape, but no significant correlation was found. The index maps drawn can be used by hydrologists to compute flood peaks. Flood peak safety factors can be based on visual observation of the index variation in the vicinity of the location for which the flood peak estimate is needed. It is noted that some designers may feel uncomfortable about being faced with a choice of several index values of highly different magnitude for a particular location. This reflects a major uncertainty in flood prediction for ungaged, and even for gaged, watersheds which could be used to discredit the method. However, the hydrologist should realize that these maps visibly display the variability in flood estimates which single valued parametric equations or contour maps tend to hide. (Baker-FRC)
W83-01665

UNIT HYDROGRAPHS VIA NONLINEAR PROGRAMING,
Texas Univ. at Austin. Dept. of Civil Engineering.
L. W. Mays, and C. -K. Taur.
Water Resources Research, Vol 18, No 4, p 744-752, August, 1982. 2 Fig, 12 Tab, 17 Ref.

Descriptors: *Unit hydrographs, *Programming, *Rainfall, Rainfall-runoff relationships, Hydrographs, Nonlinear programming, Water resources development, LSGRG, GRG2.

Two nonlinear programming codes called the LSGRG (large-scale generalized reduced gradient) technique and GRG2 (generalized reduced gradient) are used to solve a model developed for the optimal determination of unit hydrographs. The model determines both the rainfall losses for each rainfall event and the best unit hydrograph that minimizes deviations between observed and derived runoff hydrographs. Several multiperiod rainfall events can be considered simultaneously

for the unit hydrograph determination. Several examples are included to illustrate the model. (Baker-FRC)
W83-01719

AN ANALYSIS OF INPUT ERRORS IN PRECIPITATION-RUNOFF MODELS USING REGRESSION WITH ERRORS IN THE INDEPENDENT VARIABLES,
Geological Survey, Denver, CO.
B. M. Troutman.
Water Resources Research, Vol 18, No 4, p 947-964, August, 1982. 3 Fig, 10 Tab, 20 Ref.

Descriptors: *Error analysis, *Regression analysis, *Input-output analysis, Rainfall-runoff relationships, Hydrologic models, Variability, Runoff, Prediction, Flood frequency, Turtle Creek watershed, Dallas, *Texas, Model studies, Precipitation.

Errors in runoff predictions caused by input data errors, for example, those resulting from spatial variability of precipitation, were analyzed by a simple linear regression model and a nonlinear U.S. Geological Survey precipitation-runoff model. Independent variables were precipitation and other input measurements; the dependent variable was runoff. When erroneous input data were used, prediction errors were inflated and estimates of expected storm runoff for given observed input variables were biased. The biased runoff estimation, in turn, produced biased parameter estimates when the parameter estimates were obtained by a least squares fit of predicted to observed runoff values. Both models were applied to 5 years of data in the Turtle Creek Watershed, Dallas, Texas, and the errors analyzed. With respect to flood frequency, the T-year event was usually underestimated when the estimate was based on model output using correct input and parameters. Using erroneous data sometimes produced a lesser underestimation in some cases. (Cassar-FRC)
W83-01723

IDENTIFICATION OF MULTIVARIATE TIME SERIES AND MULTIVARIATE INPUT-OUTPUT MODELS,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-01734

ON THE CLIMATIC DEPENDENCE OF THE IUH: A RAINFALL-RUNOFF ANALYSIS OF THE NASH MODEL AND THE GEOMORPHOCLIMATIC THEORY,
Simon Bolivar Univ., Caracas (Venezuela). Dept. of Hydrology and Water Resources.
I. Rodriguez-Iturbe, M. Gonzalez Sanabria, and G. Caamano.
Water Resources Research, Vol 18, No 4, p 887-903, August, 1982. 15 Fig, 1 Tab, 8 Ref.

Descriptors: *Hydrologic models, *Hydrographs, *Geomorphology, Rain-runoff relationships, Model studies, Unit hydrographs, Rainfall intensity, Rainfall duration, Basins, Mamon River, *Venezuela.

Instantaneous unit hydrographs (IUH) calculated by the geomorphoclimatic theory were compared with results obtained by simulation, using the Nash rainfall-runoff model. This procedure uses rainfall intensity and duration and a given set of geomorphic characteristics to calculate peak and time to peak of an IUH. The 103 sq km Mamon River basin, Venezuela, an extensively eroded, hilly basin, was chosen as the sample basin. The three climates used in the simulation were: (1) average rainfall intensity (ir) of 3 cm per hr and average duration of rainfall (tr) of 2 hours, (2) ir of 1.5 cm per hour and tr of 1 hour, and (3) ir of 0.75 cm per hour and tr of 4 hours. Theoretical and experimental distributions of peak and time to peak of the IUH compared very well. Likewise, the peak and time to peak of the response hydrograph estimated through simple formulas assuming a triangular IUH agreed well with the Nash Model results. Uncertainty due to variability of the IUH with rainfall input (traditional approach) was capable of providing sizeable variance of estimates in the outflow hydrograph when working under the assumed nonlinear framework. (Cassar-FRC)
W83-01737

A GEOMORPHOCLIMATIC THEORY OF THE INSTANTANEOUS UNIT HYDROGRAPH,
Simon Bolivar Univ., Caracas (Venezuela). Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2B.
W83-01738

A MODELING SCHEME FOR THE STUDY OF DRAINAGE DENSITY,
Simon Bolivar Univ., Caracas (Venezuela).
For primary bibliographic entry see Field 2E.
W83-01741

2B. Precipitation

STATE OF MONTANA ACTIVITIES IN THE HIGH PLAINS COOPERATIVE PROGRAM: 1975-1980,
Montana Dept. of Natural Resources and Conservation, Helena.
For primary bibliographic entry see Field 3B.
W83-01636

A SIMPLIFIED GAMMA PROBABILITY MODEL FOR ANALYSIS OF THE FREQUENCY DISTRIBUTION OF RAINFALL IN THE REGION OF CAMPINAS, SP, BRAZIL,
Instituto Agronomico, Sao Paulo (Brazil).
H. V. De Arruda, and H. S. Pinto.
Agricultural Meteorology, Vol 22, No 2, p 101-108, November, 1980. 2 Tab, 8 Ref.

Descriptors: *Mathematical models, *Precipitation, *Data interpretation, *Frequency distribution, Model studies, Rainfall distribution, Rainfall disposition, Rainfall intensity, Mathematical studies, Hydrologic models, *Brazil, Capinas.

An exponential frequency distribution model was used to interpret five-day precipitation totals in Campinas, SP, Brazil. This simplified exponential model was shown to be as accurate as the Gamma and the 'Transformed Normal' distributions for fitting expected to observed frequencies for the whole year. The model equates the function of the amount of rainfall per day, (x), with the product of the log normal of the constant A (which is > 1) and A to the -x power. The value for x was derived from five-day precipitation totals which were calculated for each year. The model was found to be a Gamma distribution with the gamma parameter constant and equal to one. This allowed rapid data interpretation with an inverted J-curve frequency distribution. (Geiger-FRC)
W83-01677

A NEW CRYOSCOPIC METHOD FOR DETERMINING RAINDROP SIZE WITHOUT A CALIBRATION CURVE,
Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
P. Bazzoffi.
Agricultural Meteorology, Vol 22, No 1, p 35-43, July, 1980. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Rain, *Cryogenics, Kinetics, Freezing, Fluid drops, Physical properties, Particle size.

A cryogenic method for measuring the kinetic raindrop size based on the weight of the drops rather than the ratio of the mass of drops and the mass of the pellets formed by the drops in the flour (flour-pellet method) is described. In the new method, drops are frozen by liquid nitrogen as soon as they fall into the flour. The difference between pellet weight after freezing and pellet weight after drying determines the raindrop weight and consequently, its diameter. The little flour still remaining on the pellet is eliminated by means of washing. Frozen pellets can be stored in a metal capsule which is kept in liquid nitrogen or analyzed directly in a Dewar vessel filled with liquid nitrogen and equipped with a column of sieves of various mesh sizes. The present technique eliminates need for calibration curves, thereby increasing speed, accuracy, and standardization of measurements. (Geiger-FRC)
W83-01678

WET AND DRY YEARS,
Ministry of Works and Development, Christchurch (New Zealand). Science Centre.
A. Tomlinson.
Soil and Water, Vol 16, No 5, p 3-4, October, 1980. 2 Fig.

Descriptors: *Rainfall, *Solar activity, *Weather patterns, Weather data collections, Weather, Sunspots, Meteorological data collections, Spatial distribution, Temporal distribution, *New Zealand.

Possible relationships between earth's long-term weather experiences and sun activity are explored. There are very good indications that the earth's atmosphere is not isolated from solar variability. There is widely acceptable evidence that a 22 year rhythm in drought occurrence in the western United States is related to the Hale sunspot cycle. On a time scale of a few days there is a similarly well accepted result relating solar activity to the tendency for atmosphere over New Zealand to contain more or fewer anticyclones or depressions. There appears to have been a peak in the rainfall in each decade from 1900 to 1979. The sunspot series also peaks in each decade, suggesting that the inter-relation of rainfall and sunspot series may be worth examining. Near a sunspot maximum a year is more likely to be wet than dry. It appears that about 1983-86 New Zealand may experience a period of generally dry weather. (Baker-FRC)
W83-01686

THE MEDITERRANEAN HEAT STORAGE AND ISRAELI PRECIPITATION,
Geophysical Engineering, Ltd., Yavne (Israel).
E. Tzvetkov, and G. Assaf.
Water Resources Research, Vol 18, No 4, p 1036-1040, August, 1982. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Precipitation, *Weather forecasting, *Water temperature, *Mediterranean Sea, Israel, Heat storage, Rainfall, *Israel.

Heat storage in the upper layer of the southeast Mediterranean Sea at the beginning of the winter season is fairly well correlated ($R = 0.55$) with subsequent precipitation in Israel. Heat storage depletion and precipitation are very well correlated ($R = 0.9$). The thermal gradient reflects atmospheric conditions, which are difficult to predict, and the seasonal heat stored in the water. When the effective temperature (heat storage) is above 20.4C, annual rainfall is not less than average. When the effective temperature is below 19.8C, annual rainfall will not exceed the average. These conclusions were confirmed by rainfall data measured at Jerusalem, Tel-Aviv, and Haifa, and heat storage in the sea during 11 seasons, 1952-1969. (Cassar-FRC)
W83-01712

A GEOMORPHOCLIMATIC THEORY OF THE INSTANTANEOUS UNIT HYDROGRAPH,
Simon Bolivar Univ., Caracas (Venezuela). Dept. of Hydrology and Water Resources.
I. Rodiriguez-Iturbe, M. Gonzalez-Sanabria, and R. L. Bras.
Water Resources Research, Vol 18, No 4, p 877-886, August, 1982. 7 Fig, 13 Ref.

Descriptors: *Hydrologic models, *Hydrographs, *Geomorphology, Rainfall-runoff relationships, Model studies, Climatic data, Unit hydrographs, Rainfall intensity, Rainfall duration, Probability density functions, Basins.

The instantaneous unit hydrograph (UIH) is described as a random function of climate and geomorphology, varying with the characteristics of rainfall excess. The probability distribution function of the peak and time to peak of the IUH are analytically derived as functions of the rainfall characteristics and the basin geomorphological pa-

rameters. The concept of the geomorphoclimatic IUH is given. It estimates peak and time to peak of IUH from a given set of geomorphological characteristics and a particular intensity and duration of rainfall. It explains why IUH from different storms in the same basin vary. It avoids problems produced by noise corruption in rainfall and runoff and by subjective estimates of effective rainfall estimation and spatial distribution. The variance of the peak probability distribution function is much smaller for low rainfall intensities than for greater intensities. The variance of the time to peak probability distribution function shows the opposite behavior. However, the coefficient of variation is constant in both distributions, independent of climate and geomorphology. (Cassar-FRC)
W83-01738

2C. Snow, Ice, and Frost

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTH CENTRAL SOIL CONSERVATION RESEARCH LABORATORY,
For primary bibliographic entry see Field 7B.
W83-01461

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTHWEST WATERSHED RESEARCH CENTER, BOISE, IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7A.
W83-01464

AN INEXPENSIVE REMOTE SNOW-DEPTH GAUGE BASED ON ULTRASONIC WAVE REFLECTION FROM THE SNOW SURFACE,
Eidgenoessische Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
For primary bibliographic entry see Field 7B.
W83-01498

SURGES FROM ICE JAM RELEASES: A CASE STUDY,
Canada Centre for Inland Waters, Burlington (Ontario).
S. Beltaos, and B. G. Krishnappan.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 276-284, June, 1982. 8 Fig, 11 Ref.

Descriptors: *Ice jams, *Mathematical equations, *Ice breakup, Ice-water interfaces, Flow measurement, Flow velocity, Velocity, Ice cover, Water depth, Model studies, Athabasca River, *Alberta.

The governing differential equations of the ice-water surge phenomenon are formulated and used to reconstruct the observations reported by earlier investigators of the ice breakup on the Athabasca River at Fort McMurray being triggered by the release of a major ice jam upstream. Witnesses to spring ice breakup in rivers frequently mention violent ice runs with extreme water speeds and rapidly rising water levels. The derived equations indicate that the problem, with plausible approximations, may be treated as one-dimensional, open-water flow of total depth H identical to that of the ice-water flow, and average velocity V. This applies to situations where the river is free of ice downstream of the released ice jam. Though this does occur in nature occasionally, the downstream reach is often covered with an undisturbed or deteriorated ice sheet. Arrival of the surgelifts breaks and sets in motion this ice sheet. The phenomenon is too complex to model, but the main effect is to retard the advance of the surge. The data from the Doyle and Andres study pertaining to the Athabasca River were reprocessed to define the initial and boundary conditions needed for the computation. Stream geometry was defined on the basis of several surveyed cross sections; each was approximated by a rectangle of average width and depth for simplicity. From the given data it appeared that the surge in question was arrested at a location no more distant than 14 km below MacEwan Bridge. This was less than 2 hr after the jam release. A new jam then formed, causing further stage increases. (Baker-FRC)
W83-01538

RESISTANCE COEFFICIENTS FROM VELOCITY PROFILES IN ICE-COVERED SHALLOW STREAMS,
Cold Regions Research and Engineering Lab., Hanover, NH.
D. J. Calkins, D. S. Deck, and C. R. Martinson.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 236-247, June, 1982. 4 Fig, 7 Tab, 7 Ref.

Descriptors: *Resistance, *Ice cover, *Water circulation, *Velocity, Stream discharge, Hydrology, Roughness coefficient, Hydraulic roughness, Shallow water, Water depth.

An evaluation is presented of the needed accuracy and the limitations of the velocity profiles for streams where the flow depth is less than 1 m should be employed with caution. Small velocity probes resistant to ice clogging, such as the two-directional magnetic flow sphere, are ideal. The minimum distance from the boundary to the position of maximum velocity for which reasonable calculated values can be expected is around 15-20 cm with such equipment. The depth measurement needs to be accurate within 1 cm for shallow rivers. The average shear stresses for slush ice and solid ice interfaces can be significantly different, with generally higher shear stresses for the frazil accumulations immediately after deposition. The primary use hydraulic resistance coefficients is for backwater computations with and without ice effects. The use of velocity profiles to calculate the shear stress or resistance coefficient in shallow streams appeared to be very unreliable unless the profile data are carefully scrutinized. The accuracy of the depth measurement was shown to be critical. The most consistent data on ice roughness coefficients appear to be obtained from cross-sectional data, using only the mean velocities obtained from the velocity profiles and subdividing the flow into the bed and ice sections. The computation for backwaters with a stationary ice cover is straightforward as long as a downstream control section is present. The roughness coefficient of the ice is not as sensitive as the other parameters when combined with the bed values to produce a composite value in changes to the overall depth prediction. (Baker-FRC)
W83-01540

THE PERMEABILITY OF A MELTING SNOW COVER,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Colbeck, and E. A. Anderson.
Water Resources Research, Vol 18, No 4, p 904-908, August, 1982. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Permeability, *Snow cover, *Melting, Snowmelt, Lysimeters, Snow density, Ice layers, Gravity flow theory, California, Vermont.

The intrinsic or saturated permeability of a well-metamorphosed, melting snow cover was determined to be in the range of 10-40 times 10 to the minus 10th power sq meters. These results were obtained from snowmelt and runoff data collected at 2 lysimeters, one in California's Central Sierra Snow Laboratory and one in Vermont. The unsaturated permeability increased at about the third power of liquid saturation. Results generally supported the gravity flow theory for snow. As expected, permeability decreased with increasing snow density. For a given snow density, the permeability was higher in California, possibly because Vermont snow contained more ice layers. (Cassar-FRC)
W83-01715

2D. Evaporation and Transpiration

USING LEAF TEMPERATURE TO ASSESS EVAPOTRANSPIRATION AND ADVECTION,
Kansas State Univ., Manhattan. Dept. of Agronomy.
C. R. Sumayao, E. T. Kanemasu, and T. W. Brakke.
Agricultural Meteorology, Vol 22, No 2, p 153-166, November, 1980. 9 fig, 3 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Energy, *Air temperature, *Heat balance, *Corn, *Sorghum, *Water stress, Crop production, Transpiration, Soil water, Radiation, Available water, Water potentials, *Advection.

The rates and patterns of evapotranspiration by corn and sorghum under different soil water contents are related to the patterns of leaf and air temperatures. The sensible heat flux toward the crop canopy is an important source of energy for exapotranspiration. During the 1978 growing season, the energy balances of corn and of sorghum were determined through measurements of actual evapotranspiration, net radiation, and soil heat flux. Soil water content, stomatal resistance, leaf-water potential, and air and leaf temperatures were also determined. In general, the evapotranspiration of well-watered crops with full cover nearly equaled the net radiation, However, on days when the air temperature was over 33 degrees, the sensible heat flux was toward the cooler canopy, resulting in evapotranspiration greater than net radiation. When over 35% of available soil moisture was depleted, wilting occurred, and the leaf temperatures rose above air temperatures due to reduced transpiration rates. It is suggested that differences in leaf and air temperatures may serve as a useful indicator of plant stress. (Geiger-FRC)
W83-01679

DROUGHT ADAPTATION OF COWPEA. IV. INFLUENCE OF DROUGHT ON WATER USE, AND RELATIONS WITH GROWTH AND SEED YIELD,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
For primary bibliographic entry see Field 3F.
W83-01680

DROUGHT ADAPTATION OF COWPEA. II. INFLUENCE OF DROUGHT ON PLANT WATER STATUS AND RELATIONS WITH SEED YIELD,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
For primary bibliographic entry see Field 3F.
W83-01681

MODELS OF ALFALFA YIELD AND EVAPOTRANSPIRATION,
Neveda Univ., Reno. Dept. of Plant, Soil, and Water Science.
For primary bibliographic entry see Field 3F.
W83-01683

ESTIMATING POTENTIAL EVAPOTRANSPIRATION,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves, and Z. A. Samani.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR3, p 225-230, September, 1982. 1 Tab, 12 Ref.

Descriptors: *Evapotranspiration, *Hargreaves Method, Evaporation pans, Jensen-Haise equation, Blaney-Criddle equation, Solar radiation, Humidity, Air temperature, Temperature.

Four methods for estimating evapotranspiration or reference crop evapotranspiration were compared. In order to preference they were: Class A evaporation pan sited in an irrigated grass pasture, the Hargreaves Method, the Jensen-Haise equation, and the Blaney-Criddle f factor. The Hargreaves equation (Evapotranspiration = 0.0075 x solar radiation at the surface x mean temperature for the period) was modified by eliminating the solar radiation measurement and adding a temperature coefficient, extraterrestrial radiation, and the difference

between mean maximum and mean minimum temperatures. This proposed method is simple, reliable, and easily used in areas of the world where detailed weather data are scarce. (Cassar-FRC)
W83-01684

A FIELD STUDY ON LEAF WATER POTENTIAL, TRANSPIRATION AND PLANT RESISTANCE TO WATER FLOW IN RICE,
International Rice Research Inst., Los Banos Laguna (Philippines). Dept. of Agronomy.
V. S. Tomar, and J. C. O'Toole.
Crop Science, Vol 22, No 1, p 5-10, January/February, 1982. 4 Fig, 33 Ref.

Descriptors: *Water potential, *Transpiration, *Water stress, Leaves, *Rice, Water deficit, Stomatal transpiration, Air temperature, Water transport.

Leaf water potential (LWP), transpiration rate, stomatal resistance, and leaf and air temperatures were measured on four rice cultivars: M1-48 (a dryland variety), Dular (a dual wetland and dryland variety), and IR36 and IR20 (both wetland varieties), grown in a fully irrigated wetland field in the Philippines during the dry season of 1978. During peak periods of transpiration, LWP measured hourly on two clear days 41 days after planting were reduced to the minimum levels as follows: IR20, -17 bars; M1-48 and Dular, -15 bars; and IR36, -16 bars. Lowest LWP were observed between 1000 and 1400 hours. Measured transpiration rates (cu cm per sq cm per day) were: IR20, 0.71; and M1-48, 0.58. Maximum transpiration rates (cu cm per sq cm per hour) were: IR20, 0.11; and M1-48, 0.085. A curvilinear relationship between plant resistance and transpiration rate was observed. Hysteresis was observed in the LWP:transpiration relationship. IR20 was more sensitive for a change in LWP with transpiration than M1-48. IR20 developed stress more readily and recovered faster than M1-48. (Cassar-FRC)
W83-01689

A VOLUMETRIC LYSIMETER SYSTEM FOR USE WITH PUDDLED RICE AND ITS ROTATIONAL CROPS,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 7B.
W83-01698

2E. Streamflow and Runoff

DEVELOPMENT OF CURVES THAT REPRESENT TRENDS IN SELECTED HYDRAULIC VARIABLES FOR THE SACRAMENTO RIVER AT BUTTE CITY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
D. E. Burkham, and R. Guay.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Papercopy $3.25, Microfiche $3.50. Geological Survey Open-File Report 81-693, November 1981. 22 p, 9 Fig, 1 Tab, 5 Ref.

Descriptors: *Streamflow, *Stage-discharge relation, *Velocity, Flow duration, *California, *Sacramento River.

Streamflow records for the Sacramento River at Butte City, California, are used to develop curves that represent trends in discharges, stages, and velocities that are equaled or exceeded 95, 90, 75, 50, and 25 percent of the time. (USGS)
W83-01404

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE CENTRAL WISCONSIN RIVER BASIN, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
W. A. Gebert.
Geological Survey Open-File Report 81-495 (WRI), March 1982. 99 p, 9 Fig, 2 plates, 6 Tab, 21 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Regression analysis, Evaluation, Base flow, Flow characteristics, Flow duration, Flow rates, *Wisconsin, *Central Wisconsin River basin, Low-flow frequency.

Low-flow characteristics of streams in the central Wisconsin River basin are presented. Included are estimates of low-flow frequency at 34 gaging stations, flow duration at 24 gaging stations, and low-flow frequency characteristics at 18 low-flow partial-record stations and 131 miscellaneous sites. Equations are provided to estimate low-flow characteristics at ungaged sites and at sites where one base-flow discharge measurement is available. The equations were determined from multiple-regression analyses that related low-flow characteristics at gaging stations and low-flow partial-record stations to basin characteristics. The standard error of estimate is provided for each method of estimating the annual minimum 7-day mean flow below which the flow will fall on the average of once in 2 years and once in 10 years. The standard error of estimate for the 7-day 10-year low flow ranged from 10 percent to 140 percent, depending on the area and type of data available. Standard error provides the user with the expected degree of accuracy for each method. (USGS)
W83-01406

PREDICTION OF MEAN ANNUAL FLOWS IN THE FRASER RIVER CATCHMENT, BRITISH COLUMBIA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Waylen, and M-K. Woo.
Water Resources Bulletin, Vol 18, No 4, p 707-711, August, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Flow profiles, *Prediction, *Catchments, Flow, Gaussian distribution, Mathematical studies, Fraser River, Rivers, *British Columbia.

This study attempts to combine two approaches to predicting mean annual flows by fitting an empirical distribution to mean annual flows and then applying a statistical method to describe the spatial variation of the estimated parameters. The method developed is applied to the Fraser River catchment. Statistical tests show the annual flow records to be stationary and serially independent and able to be adequately approximated by Gaussian distributions. Estimates are made of the Gaussian parameters for each subbasin. The spatial variations of these parameters are described by third order trend surfaces. The fitted surfaces can then be used to predict parameters of ungaged basins using the latitude and longitude of the basin centroids. The predicted parametric values are substituted into the Gaussian distribution to generate flows of various return periods. (Baker-FRC)
W83-01479

PREDICTION OF ANNUAL FLOODS GENERATED BY MIXED PROCESSES,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Waylen, and M. K. Woo.
Water Resources Research, Vol 18, No 4, p 1283-1286, August, 1982. 5 Fig, 5 Ref.

Descriptors: *Flood control, *Frequency analysis, Mathematical studies, Snowmelt, Rainfall, Cascade Mountains, Gumbel distribution, Frequency distribution, Probability distribution, Regional analysis, *Pacific Northwest.

A method of flood frequency estimation is proposed using the recognition and incorporation of the distinct characteristics of flood-generating processes. In areas where the annual flood series is generated by more than one distinctive hydrologic process, the Gumbel distribution does not provide a satisfactory fit. Physical evidence is used to identify the flood generating processes, which in the Cascade Mountains of the Pacific Northwest include snowmelt and rainfall. Individually, the snowmelt and rain generated annual floods are adequately modeled by simple Gumbel distributions. These distributions have to be compounded to provide a good fit to the annual floods which are produced by mixed processes. (Baker-FRC)
W83-01493

FLOOD PEAKS AND DISCHARGE SUMMARIES IN THE DELAWARE RIVER BASIN,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-01509

LOW FLOWS OF MASSACHUSETTS STREAMS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
J. W. Male, and H. Ogawa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150003, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center, Amherst, Publication 125, February 1982. 160 p, 13 Fig, 6 Tab, 42 Ref, 2 Append. OWRT A-115-MASS(1), 14-34-0001-0123.

Descriptors: *Low flow, *Stream discharge, *Catchment areas, *Massachusetts, *Water quality measurement, Regression analysis, Climate, Social aspects, Prediction, Wastewater treatment, Cost analysis.

The U.S. Geological Survey maintains approximately 100 streamflow gaging stations in Massachusetts for which mean daily flow rates are recorded and stored in a computerized retrieval system. Daily streamflow data were used to generate low-flow characteristics using the annual series and partial duration series methods. Multiple regression analyses were performed to study the relationship between the low-flow characteristics and a number of independent variables including drainage basin characteristics, climatic factors, and societal influences. The analyses were conducted using 36 different low-flow characteristics as dependent variables, ranging in duration from two days to three years and in recurrence interval from two to 25 years. The results of the analyses indicated that although the low flows with shorter durations and longer recurrence intervals cannot be predicted with great accuracy, the longer duration low flows can be estimated accurately. The drainage basin area was the most important factor in predicting low flows in all cases. A procedure was developed to evaluate the 7-day 10-year low flow in the context of water quality management. The technique allows an analyst to evaluate the effect of different low-flow characteristics on the costs of wastewater treatment to maintain water quality criteria. Results showed that the 7-day 10-year low flow is a very conservative basis for determining allowable water quality. (Moore-SRC)
W83-01528

PREDICTION OF CHANNEL DEFORMATIONS OF RIVERS AND CANALS,
For primary bibliographic entry see Field 8B.
W83-01556

QUANTITATIVE EVALUATION OF FACTORS AFFECTING FLASH FLOODS ON EPHEMERAL WATERSHEDS,
Nevada Univ. System, Reno. Desert Research Inst.
M. E. Campana, A. B. Cunningham, A. S. Navoy, and R. L. Bateman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150144, Price codes: A02 in paper copy, A01 in microfiche. Publication No 41072, July 1982. 24 p, 5 Tab, 10 Fig, 8 Ref. OWRT A-075-NEV(1), 14-34-0001-7060.

Descriptors: *Flash floods, Ephemeral streams, Channel morphology, Rainfall-runoff relationships, Mannings equation, *Nevada, *Simulation, *Model studies, *Watershed models.

Flash floods on ephemeral watersheds can be extremely destructive in terms of lives and property. Reliable runoff models suitable for ungaged watersheds are essential for the delineation of flood-prone areas so that proper planning, management and engineering measures can be implemented. A watershed model utilizing the kinematic wave approximation was successfully used to simulate peak flow on a southern Nevada watershed; simulated

time to peak was somewhat conservative. In a sensitivity analysis on a test basin with a test storm, peak flow estimates were relatively insensitive to variations in plane and channel slopes and values of Manning's n, but were very sensitive to plane and channel infiltration properties. Times to peak were sensitive to plane values of Manning's n and slope, but less so to these channel properties. Accurate simulation of peak flow and time to peak with physically-based models requires good estimates of plane properties and watershed infiltration parameters. Future investigations should be oriented toward studies involving gaged basins and the effects of various parameters on the entire hydrograph.
W83-01606

THE USE OF FLOOD POTENTIAL INDICES FOR FLOOD PEAK ESTIMATION ON UNGAGED WATERSHEDS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W83-01665

ESTIMATION OF ARMA MODELS WITH SEASONAL PARAMETERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, D. C. Boes, and R. A. Smith.
Water Resources Research, Vol 18, No 4, p 1006-1010, August, 1982. 21 Ref.

Descriptors: *Time series analysis, *Model studies, *Seasonal variation, Regression analysis, *ARMA models, Stochastic hydrology, Hydrologic models.

The Yule-Walker equations for ARMA(p,q) models with periodic parameters are given. Exact moment estimates and their corresponding parameter spaces can be derived from these equations. For the case of ARMA(p,l) models the periodic autoregressive parameters can be found by solving a system of linear equations. The periodic moving average parameters satisfy a system of equations which can be solved iteratively. Sensible differences exist between the proposed exact moment estimators and corresponding approximation. (Cassar-FRC)
W83-01716

A COMPARISON OF FOUR STREAMFLOW RECORD EXTENSION TECHNIQUES,
Geological Survey, Reston, VA.
R. M. Hirsch.
Water Resources Research, Vol 18, No 4, p 1081-1088, August, 1982. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Streamflow forecasting, *Time series analysis, *Surface water records, Regression analysis, Simulation, Statistical analysis, Low flow, *Virginia.

Four models for extending an existing gage record in time were compared. These correlate the records at the station of interest with a nearby, long-term base station. The methods were REG (linear regression), RPN (regression plus noise), MOVE.1, and MOVE.2 (Maintenance of Variance Extension). MOVE.1 is also known as the line of organic correlation, reduced major axis, unique solution, or equivalence line method. Comparison was based on bias and standard error of estimate of moments and order statistics. Monthly records collected over 50 years at 7 Virginia streams were used in an empirical check of the methods. The method producing best results was MOVE.2, followed closely by MOVE.1. REG and RPN were substantially inferior. Specifically, REG did not provide records with appropriate variability; RPN did not provide records with appropriate distribution shape or serial correlation. (Cassar-FRC)
W83-01721

ARMA MODEL IDENTIFICATION OF HYDROLOGIC TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, and J. T. B. Obeysekera.
Water Resources Research, Vol 18, No 4, p 1011-1021, August, 1982. 5 Fig, 17 Tab, 13 Ref.

Descriptors: *Time series analysis, *Model studies, *Streamflow, *ARMA models, Hydrologic models, Correlation analysis, *St. Lawrence River, *Nile River, Regression analysis.

The identification of the appropriate order of ARMA models (autoregressive moving average) is done using the generalized partial autocorrelation function (GPAF) and the R and S functions of Gray et al. (1978). The three functions are defined, and some tables of recursive relations are presented for use in programming and implementation. All three functions have certain characteristic patterns useful in ARMA model identification. Four examples demonstrate the identification technique. Annual streamflow data from the St. Lawrence River (1860-1957) and the Nile River at Aswan (1870-1945) were used to determine the order of the ARMA models used in these applications. (Cassar-FRC)
W83-01722

OPTIMAL CHOICE OF TYPE AND ORDER OF RIVER FLOW TIME SERIES MODELS,
Purdue Univ., Lafayette, IN. School of Engineering.
A. Ramachandra Rao, R. L. Kashyap, and L. -T. Mao.
Water Resources Research, Vol 18, No 4, p 1097-1109, August, 1982. 2 Fig, 8 Tab, 26 Ref.

Descriptors: *Time series analysis, *River flow, Model studies, Decision rule, Autoregressive models, Stochastic hydrology.

A decision rule derived from the Bayes criterion was used to compare the performance of several models for river flows. The decision rule minimized the probability of error. Models investigated were the autoregressive (AR), moving average (MA), autoregressive moving average (ARMA), autoregressive integrated moving average (ARIMA), and seasonal ARIMA. Annual or monthly data from 13 rivers from watersheds 27.6 to 710,000 sq miles and synthetic data were used. Models for the log transformed monthly data were better than models fitted to observed data without transformation. It was possible to choose the type and order of model most appropriate for each situation. The prior probability density function was not significant when the number of observations was large. (Cassar-FRC)
W83-01724

PALEOHYDROLOGY OF SOUTHWESTERN TEXAS,
State Univ. of New York Coll. at Fredonia. Dept. of Geology.
R. C. Kochel, V. R. Baker, and P. C. Patton.
Water Resources Research, Vol 18, No 4, p 1165-1183, August, 1982. 11 Fig, 8 Tab, 50 Ref.

Descriptors: *Paleohydrology, *Flood recurrence interval, *Sedimentology, Pecos River, Devils River, *Texas, Semiarid lands, Flashy streams, Flood frequency, Historic floods, Radioactive dating, Dating, Organic matter, Statistical analysis, Slack-water sediments, Alluvial deposits, Tributaries, Stratigraphy, Flood discharge.

Paleoflood discharge and frequency estimates in the lower Pecos and Devils Rivers in semiarid southwestern Texas were extended over 10,000 years by studying slack-water flood sediments. These deposits are usually fine-grained sand and silt that accumulate during floods in areas where current velocity is reduced, such as in backflooded tributary mouths, channel expansions, downstream from bedrock spurs and/or slump blocks, and along bedrock walls in shallow caves. Radiocarbon dating of organic debris in slack-water deposits established the flood chronology; paleoflood discharges were estimated by slope-area methods. This information, which greatly extended the flood records, was weighted in log Pearson type 3 calculations of flood frequency. Two historical floods in this area occurred in 1954 and 1974. Using conventional techniques produced recurrence intervals of 81 to 10 million years for the 1954 event. Using geomorphic data derived from slack-water sediment data produced a more realistic estimate of about 2000 years for the 1954 flood and about 500-700 years for the smaller 1974 flood. (Cassar-FRC)
W83-01727

IDENTIFICATION OF MULTIVARIATE TIME SERIES AND MULTIVARIATE INPUT-OUTPUT MODELS,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. M. Cooper, and E. F. Wood.
Water Resources Research, Vol 18, No 4, p 937-946, August, 1982. 4 Tab, 21 Ref.

Descriptors: *Streamflow, *Time series analysis, *Model studies, Multivariate analysis, Runoff, Rainfall-runoff models, Hydrology, Hydrologic models, Correlation analysis, *ARMA models, Florida, New York, Columbia River.

A procedure for identifying the structure and order of multiple input, multiple output linear models is presented. It uses canonical correlations to determine the structure of the state vector and to give initial parameter estimates. Equivalence between the state-space formulation and multivariate ARMAX model (autoregressive moving average with exogenous inputs) is discussed. Examples include a multiple input (3 precipitation events), single output daily rainfall-runoff model used on data from the Hillsborough River, Florida; a four-site model of monthly streamflows used on New York state streams; and a four-season streamflow model with one observation made each season on the Columbia River. (Cassar-FRC)
W83-01734

A MODELING SCHEME FOR THE STUDY OF DRAINAGE DENSITY,
Simon Bolivar Univ., Caracas (Venezuela).
L. A. Escobar, and I. Rodrigues-Iturbe.
Water Resources Research, Vol 18, No 4, p 1029-1035, August, 1982. 11 Fig, 1 Tab, 15 Ref.

Descriptors: *Drainage density, *Overland flow, *River basins, Model studies, Rainfall-runoff relationships, Erosion, *Puerto Rico, Hydrologic models, Forest watersheds, Rain forests, Watersheds.

The drainage density of a watershed was estimated by calculating the length of no-erosion in a basin from climatic and geomorphologic characteristics, which were determined by coupling a rainfall model, a runoff model, and an erosion model. The model took into account the convergence of overland flow, which is a major cause of the growth upslope of the channels comprising the networks. Also included was a simple approximation to the evolution in time of the contributing area at the source. The model was used to study two rain forest basins (Morovis and Unibon) in the Indio Basin wastershed in northern Puerto Rico. For Unibon and Morovis, respectively, the analytically estimated lengths of no-erosion were 288 m and 273 m, yielding drainage values of 1.74 km per sq km (measured, 1.41 km pe sq km) and 1.83 km per sq km (measured, 1.69 km per sq km). By eliminating all streams of Order 1, the number of segments was reduced from about 50 to 5, giving drainage densities o 1.34 km per sq km for Unibon and 2.01 km per sq km for Morovis. (Cassar-FRC)
W83-01741

2F. Groundwater

RAPID WATER TABLE RISE,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien.
Water Resources Bulletin, Vol 18, No 4, p 713-715, August, 1982. 10 Ref.

Descriptors: *Water table, *Groundwater, *Hydrology, Humid areas, Humid climates, Rainfall, Infiltration, Water table fluctuations, Groundwater movement, Water table rise, Water level fluctuations, Unconfined aquifers.

Very rapid rises in the water table have been reported following minor applications of moisture to the soil surface. The phenomenon appears to result from the conversion of a capillary fringe to phreatic water. The rapid water table rise and the apparent physical process may be quite significant to the understanding of several hydrologic phenomena, and may be a common link in explaining several seemingly diverse phemomena which characterize non-Hortonian runoff in a humid environment. Under certain conditions storm peaks are dominated by flow from small, restricted variable source areas that contributed runoff when saturated from below by rising water tables. For other streams, ground water inputs form the major part of the flood peak. The explanation for these observations could lie in an understanding of the rapid water table rise phenomenon. Such a mechanism would provide the means for producing saturation at or near the surface shortly after rainfall begins if it were widespread. Such conditions should be carefully analyzed, particularly in defining the true role of this event in the hydrology of humid environments. (Baker-FRC)
W83-01478

VERIFICATION OF SOME GEOHYDROLOGICAL IMPLICATIONS OF DEEP WEATHERING IN THE BASEMENT COMPLEX OF NIGERIA,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Journal of Hydrology, Vol 56, No 3/4, p 347-368, April, 1982. 9 Fig, 6 Tab, 37 Ref.

Descriptors: *Groundwater potential, *Weathering zone, *Geohydrology, Basement Complex, *Nigeria, Regolith, Baseflow, Wells, Humid climates, Saturated zone.

The subsurface hydrology in four areas of the Nigerian Basement Complex was studied with emphasis on the depth and pattern of weathering. Mean weathering depths (in m) were: Dan Mongu, 31.19; Ife, 20.32; Middle Osun Valley, 13.20; and Middle Ose Valley, 12.94. Mean saturated zone thicknesses (in m) were: Dan Mongu, 10.38; Ife, 13,85; Middle Osun Valley, 8.20; and Middle Ose Valley, 9.72. This region was characterized by a generally widespread saturated zone in the regolith rather than a series of isolated groundwater compartments as would be expected from the basin and dome weathering pattern. The saturated zone thickness and weathering depth were strongly correlated. The temporal variation pattern of saturated zone thickness conformed to the seasonal pattern of rainfall distribution typical of most parts of the country. Conditions necessary for the above geohydrological conditions are thick and widespread regolith, flat or gently undulating terains with minimal overland flow and subaerial regolith erosion, and adequate rainfall. The major rivers in the Basement Complex derive a proportion (as yet known) of baseflow from the saturated regolith. In this region it is not relevant to look for basins of decomposition for siting wells in deeply weathered landscapes. The success of a well may be readily estimated prior to digging or drilling. Wells should be sunk during the dry season to ensure greatest reliability and yield throughout the year. (Cassar-FRC)
W83-01490

APPROXIMATE SOLUTION OF THE PROBLEM OF THE SHAPE OF THE INTERFACE IN A SEMI-CONFINED AQUIFER,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
J. C. Van Dam, and P. C. Sikkema.
Journal of Hydrology, Vol 56, No 3/4, p 221-237, April, 1982. 10 Fig, 1 Tab, 6 Ref.

Descriptors: *Saline-freshwater interfaces, *Groundwater movement, *Polders, Aquifers, Geohydrology, Differential equations, *The Netherlands, Saline water intrusion, Coastal aquifers, Semiconfined aquifers.

Nonlinear ordinary second-order differential equations are used to describe the interface between steady-flowing fresh groundwater and stagnant saline groundwater in a semiconfined aquifer. Assumptions are made that flowlines are horizontal in the aquifer and vertical in the semipermeable top layer and that the interface is sharp. Reduced dimensionless variables are used instead of depth of interface and distance. An approximate solution is developed. The accuracy of their solution is good. Examples of applying the solution to several polders in succession are given. It is possible to account for changes in geohydrological constants and polder levels as a function of distance and to introduce abstractions or injections of fresh water at any location. (Cassar-FRC)
W83-01491

ANALYTICAL FORMULAE FOR THE SHAPE OF THE INTERFACE IN A SEMICONFINED AQUIFER,
Technische Hogeschool, Delft (Netherlands). Mathematics Branch.
P. C. Sikkema, and J. C. Van Dam.
Journal of Hydrology, Vol 56, No 3/4, p 201-220, April, 1982. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Saline-freshwater interfaces, *Groundwater movement, *Polders, Aquifers, Geohydrology, Differential equations, *The Netherlands, Saline water intrusion, Coastal aquifers, Semiconfined aquifers.

The occurrence and flow of fresh and saline groundwater in coastal areas are described by nonlinear ordinary second-order differential equations. Assumptions made are that the saline groundwater is stagnant in a semiconfined aquifer and that the interface is sharp. Analytical solutions of the differential equations are derived and presented in graphical form. These solutions are useful for describing interfaces between fresh and saline groundwater in western Netherlands, where the groundwater table is often artificially controlled at levels up to several meters below mean sea level. (Cassar-FRC)
W83-01492

MULTIDIMENSIONAL NUMERICAL SIMULATION OF FLUID FLOW IN FRACTURED POROUS MEDIA,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan.
Water Resources Research, Vol 18, No 4, p 1235-1247, August, 1982. 19 Fig, 21 Ref.

Descriptors: *Water flow, *Groundwater movement, *Geologic fractures, Porosity, Soil water, Mathematical models, Hydrodynamics, Fluid mechanics, *Integral finite difference method.

Isothermal flow of water in a variety of fractured systems is discussed in the context of a unified, integral framework. Three commonly used conceptualizations, namely, porous systems, fractured systems, and composite porosity systems, are analyzed. The integral equations are directly replaced by discretized expressions based on an integral finite difference scheme (IFDM). Because of the manner in which the IFDM scheme chooses to handle geometric inputs, it handles the three aforesaid conceptualizations with equal facility. Six illustrative examples are provided to give an idea of the variety of fracture-related problems that are of common interest, to identify the common denominators that unify these problems, and to demonstrate the power of the IFDM. (Baker-FRC)
W83-01494

A GROUNDWATER RESOURCES DATABANK IN THE KINGDOM OF SAUDI ARABIA,
MacDonald and Partners, Cambridge, England.
For primary bibliographic entry see Field 7C.
W83-01499

GROUND-WATER QUALITY IN THE VICINITY OF LANDFILL SITES, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. T. deRoche, and A. C. Razem.
Geological Survey Open-File Report 81-919 (WRI), 1981. 19 p, 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Groundwater, *Water quality, *Landfills, *Groundwater movement, Data collections, Sites, Wells, Water level, Pumping, Impaired water quality, Chemical analysis, Leachate, Solid waste disposal, Water quality standards, *Ohio, Franklin County.

The hydrogeology and ground-water quality in the vicinity of five landfills in southern Franklin County, Ohio, were investigated by use of data obtained from 46 existing wells, 1 seep, 1 surface-water site, and 1 leachate-collection site. Interpretation was based on data from the wells, a potentiometric-surface map, and chemical analyses. Four of the five landfills are in abandoned sand and gravel pits. Pumping of water from a quarry near the landfills has modified the local ground-water flow pattern, increased the hydraulic gradient, and lowered the water table. Ground water unaffected by the landfills is a hard, calcium bicarbonate type with concentrations of dissolved iron and dissolved sulfate as great as 3.0 milligrams per liter and 200 milligrams per liter, respectively. Water sampled from wells downgradient from two landfills shows an increase in sodium, chloride, and other constituents. The change in water quality cannot be traced directly to the landfills, however, because of well location and the presence of other potential sources of contamination. Chemical analysis of leachate from a collection unit at one landfill shows significant amounts of zinc, chromium, copper, and nickel, in addition to high total organic carbon, biochemical oxygen demand, and organic nitrogen. Concentrations of chloride, iron, lead, manganese and phenolic compounds exceed Ohio Environmental Protection Agency Water Quality Standards for drinking water. Water from unaffected wells within the study area have relatively small amounts of these constituents. (USGS)
W83-01521

GROUNDWATER-LEVEL VARIATION DURING SEMIDIURNAL SPRING TIDAL CYCLES ON A SANDY BEACH,
Wollongong Univ., (Australia) Dept. of Geography.
J. A. Lanyon, I. G. Eliot, and D. J. Clark.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 377-400, 1982, 10 Fig, 10 Tab, 35 Ref.

Descriptors: *Time series anlaysis, *Tidal effects, *Beach profiles, *Estuaries, *Groundwater movement, *Groundwater recharge, Mathematical studies, Tides, Tidewater, Shores, Bays, Saline-freshwater interfaces, Groundwater level, Infiltration, Morphology, *Australia, South Beach.

Water-table geometry along two beach profiles at South Beach, Wollongong, New South Wales was monitored to provide a comprehensive description of water-table changes over time in relation to tidal fluctuations and variations in beach-face configuration. Time series curves showing water-level changes at individual wells located along beach profiles indicate a dependence on tidal range and distance landward of the beach face. Swash run-up and infiltration effects make little contribution to ground water water-table levels landward of the berm crest. During the flood tide phase, the seaward edge of the water-table slopes landward and tidal changes force the groundwater level to rise. Tidally induced changes in groundwater are superimposed on a three-dimensional water-table surface related to beach morphology and groundwater recharge from the backshore zone. Groundwater responses are different on the shoreline, salient and in the embayment; a landward water-table slope prevails on the rip profile, while a seaward slope characterizes the bar profile. Whether such processes are generally representative of sandy beaches or are peculiar to the study site is yet to be established. (Geiger-FRC)
W83-01587

HYDROLOGIC INTERPRETATION OF SHALLOW SUBSURFACE TEMPERATURE DATA,

Nevada Univ. System, Reno. Desert Research Inst.
N. L. Ingraham, R. L. Jacobson, and M. E. Campana.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150136, Price codes: A03 in paper copy, A01 in microfiche. Publication No 41076, August 1982. 35 p, 2 Tab, 5 Fig, 20 Ref. OWRT A-094-NEV(1), 14-34-0001-0130.

Descriptors: *Groundwater recharge, *Groundwater movement, *Thermal gradient, *Subsurface temperature, *Nevada, Dixie Valley, Temperature data, *Infiltration, White Rock Canyon.

The temperatures of shallow holes (1 meter) in a portion of Dixie Valley, Nevada, were monitored for a period of almost two years; ten monthly surveys were conducted, in which as many as 219 holes were measured per month. The temperatures were used to delineate infiltration/recharge events and areas of suspected subsurface mountain-front recharge in the study region. The data indicated that qualitative delineation of infiltration events from flash floods is possible, as certain alluvial fans showed marked depression of shallow temperatures in the wake of the floods, but it was impossible to determine whether or not these infiltration events resulted in groundwater recharge. Shallow temperature data from one alluvial fan, the White Roch Canyon fan, in conjunction with thermal data from a 500-foot gradient hole indicated the strong possibility of thermal quenching by groundwater flow. This quenching or masking effect is believed to be caused by substantial subsurface mountain-front recharge from the White Rock Canyon area.
W83-01605

ASPECTS OF AQUIFER TEST ERROR ANALYSIS,
Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.
A. M. BenBarka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150292, Price codes: A10 in paper copy, A01 in microfiche. M. S. Thesis, 1982, 199 p, 42 Fig, 29 Tab, 55 Ref, 2 Append. OWRT B-073-ARIZ(2).

Descriptors: *Error analysis, *Aquifer characteristics, *Estimating, *Model studies, *Pumping rate, *Water level, Hydraulic models, Statistical analysis, Least squares method, Regression analysis.

Fitting parameters to aquifer models may produce parameter estimates that contain significant errors. These errors result from a relatively limited number of measurements that can be inaccurate, from the use of a wrongly or incompletely specified model, or from inefficient methods of fitting employed to estimate the hydraulic parameters. Measurements errors in pumping rate and water levels were studied experimentally. Statistical analysis revealed that they were normally distributed. For water level measurement error, the error variance was proportional to depth. Two types of estimation techniques were used: graphical and automatic methods. For the graphical method, a panel of technical persons conducted the parameter estimation. The Theis model and its approximation were linearized by the Taylor series expansion to enable the use of standard linear regression theory for statistical inference. Model error evolves from ignoring physical properties present in the aquifer system, so that resulting parameter estimates are biased. For the graphical fitting, this bias may be compensated for to some degree on the basis of experience. For the automatic method of fitting, this bias can be detected. Graphical fits to approximate the automatic fits, with an implied objective function, and have similar statistical properties, but parameter estimates produced graphically by a single person are liable to have considerable variation. Since automatic procedures can be viewed as nonlinear regression it seems reasonable to utilize automatic least squares fitting and the regression statistics as a model to study errors, their effect, and the risks inherent in aquifer tests. (Moore-SRC)
W83-01624

FINITE ELEMENT SIMULATION OF A SALTWATER/FRESHWATER INTERFACE WITH INDIRECT TOE TRACKING,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
J. L. Wilson, and A. Sa da Costa.
Water Resources Research, Vol 18, No 4, p 1069-1080, August, 1982. 9 Fig, 4 Tab, 35 Ref.

Descriptors: *Saline-freshwater interfaces, *Coastal aquifers, *Groundwater movement, *Saline water intrusion, *Finite element method, Model studies, Porous media, Aquifers, Interfaces, Boundaries, Grid models, Toe-tracking, Gravity segregated flow.

The problem of a porous media two-layer flow involving fluids of different densities (such as seawater intrusion into a coastal fresh water aquifer) separated by a sharp interface is solved using the Galerkin finite element method in one dimension. Each layer is present only over part of the domain. The transition from two layers to one constitutes a moving boundary, or toe, which is calculated as part of the solution. An indirect numerical procedure using a fixed grid is proposed to track the toe. This procedure uses Gaussian quadrature points, a nonlinear variation of layer saturation across those elements containing a moving boundary, and an imaginary extra thickness of the absent layer. The model is applied to the gravity segregation problem in which it is as accurate as and less expensive than the equivalent grid regeneration or moving grid schemes. (Cassar-FRC)
W83-01717

A STOCHASTIC-CONVECTIVE TRANSPORT REPRESENTATION OF DISPERSION IN ONE-DIMENSIONAL POROUS MEDIA SYSTEMS,
Battelle Pacific Northwest Lab., Richland, WA. Water and Land Resources Dept.
C. S. Simmons.
Water Resources Research, Vol 18, No 4, p 1193-1214, August, 1982. 9 Fig, 2 Tab, 35 Ref.

Descriptors: *Solute transport, *Dispersion, Convection, Porous media, Hydraulic conductivity, Scale effect, Stochastic hydrology, Boundary conditions, Groundwater movement, Field tests.

Dispersion coefficients measured on a laboratory scale may be inadequate for predicting dispersive transport on a field scale. A stochastic convective transport formulation based on solute travel time probability is shown to include Fickian transport only as a special subcase. When the coefficient of variation in travel time is < 1, a travel time probability associated with a lognormal distribution of hydraulic conductivity yields concentration breakthrough curves nearly equivalent to those of Fickian transport. Results suggest that, in column tracer studies, hydrodynamic dispersion may be attributed to local variations in hydraulic conductivity. Stochastic-convective transport is shown to conserve solute mass under a flux boundary condition but not under a held concentration condition. The importance of boundary conditions for properly formulated stochastic transport is emphasized. The travel time formulation is shown to link measured dispersivity and the autocovariance of local flow velocity variations that are a result of inhomogeneous media and the boundary conditions. Dispersivity exhibits a scale effect, increasing in proportion to the length of a system when the velocity correlation range is greater than that length. An expression for the effect of dispersivity, derived for the case of long-range velocity correlations, represents non-Fickian behavior. (Cassar-FRC)
W83-01718

EFFECTS OF KRIGING AND INVERSE MODELING ON CONDITIONAL SIMULATION OF THE AVRA VALLEY AQUIFER IN SOUTHERN ARIZONA,
Arizona Univ., Tuscon. Dept. of Hydrology and Water Resources.
P. M. Clifton, and S. P. Neuman.
Water Resources Research, Vol 18, No 4, p 1215-1234, August, 1982. 25 Fig, 36 Ref.

Descriptors: *Groundwater movement, *Transmissivity, *Error analysis, Variance, Hydraulic head, *Kriging, Inverse modeling, Model studies, Statistical analysis, Avra Valley aquifer, *Arizona, *Aquifers, Stochastic hydrology, Simulation analysis.

The importance of conditioning data used in simulations of groundwater flow is illustrated by stochastic modeling of steady state hydraulic heads in the Avra Valley aquifer, Arizona, at three levels of uncertainty: use of no conditioning, use of kriging, and use of a statistical inverse procedure. Variance in hydraulic head predictions was reduced 3.2 fold by kriging as compared with no conditioning, 14.3 fold by inverse modeling compared with kriging, and 46.0 fold using both kriging and inverse modeling compared with no conditioning. The unconditional simulation of steady state hydraulic heads uses log transmissivity estimates based on measured values of this parameter, disregarding the geographic location of each measurement point. Kriging, a geostatistical method, assumes that the spatial fluctuations of the log transmissivity field are the result of an intrinsic random process. The inverse modeling procedure considers the effects of flow regime. Predictions of hydraulic head obtained without conditioning the model should be interpreted with care. (Cassar-FRC)
W83-01720

LINEAR KERNELS FOR KARST AQUIFERS,
California Univ., Santa Cruz.
S. J. Dreiss.
Water Resources Research, Vol 18, No 4, p 865-876, August, 1982. 19 Fig, 16 Ref.

Descriptors: *Karst hydrology, *Groundwater movement, *Aquifer characteristics, Kernels, Hydrographs, Springs, Precipitation, Groundwater recharge, Fracture permeability, Recharge, *Missouri, National Forests.

A method for characterizing karst aquifers is based on the use of single linear kernel functions. The kernels are identified with a deconvolution technique proposed by Neuman and deMarsily (1976) by using estimated groundwater recharge during isolated storms as the system input and the rapid storm response of spring flow as the system output. For large springs the derived kernels are similar in shape and time to peak for different storms. Average kernels derived from spring flow responses for multiple storms differ in shape for different springs, but each spring responds to different storms in a regular manner. The study was conducted on 4 springs in Mark Twain National Forest, Missouri. Since the scaling factor in the moisture balance is not well understood, the kernels cannot be used to predict previously unknown storm responses. However, they are useful in estimating the storm response of a spring if the total volume of the rapid spring flow response is known. (Cassar-FRC)
W83-01726

2G. Water In Soils

EVALUATING THE SATURATED AND UNSATURATED HYDRAULIC CONDUCTIVITY OF SOILS,
Illinois State Geological Survey, Champaign.
A. Elzeftawy, and K. Cartwright.
In: Permeability and Groundwater Contaminant Transport, American Society for Testing and Materials, Special Technical Publication 746, Zimmie, T. F., and Riggs, C. O., eds., 1981, Philadelphia, Pa., p 168-181, 6 Fig, 2 Tab, 17 Ref. 0WRT A-097-ILL(4), 14-34-0001-0115.

Descriptors: *Hydraulic conductivity, *Soil water, *Computer models, *Soil water movement, Pore size, Permeability, Groundwater movement, Saturated flow, Unsaturated flow.

The flow of water through soils is often unsteady and unsaturated, for example, infiltration from ground surface draining of soils, inflow of water from irrigation channels, and land disposal of solid and liquid wastes. The purpose of this research is to develop a computer method for predicting the

behavior of flows of water in such situations. A method of calculating the saturated and unsaturated hydraulic conductivities of soils and similar porous materials based on the pore-size distribution was shown to adequately predict the experimentally measured values. For coarse-textured soil materials or materials with a relatively narrow range of pore sizes, only one matching factor is required to calculate the hydraulic conductivity/water content relationship accurately enough for many purposes. For fine-textured soil materials with a wide range of pore-size distributions, however, two or more matching factors at a water content in the 0.3 to 0.4 bar range may be needed to obtain a useful evaluation for the unsaturated hydraulic conductivity.
W83-01471

INFILTRATION MODEL IN SIMULATED HYDROGRAPHS,
Technische Univ., Dresden (German D.R). Bereich Hydrologie and Meteorologie.
G. Peschke, and M. Kutilek.
Journal of Hydrology, Vol 56, No 3/4, p 369-379, April, 1982. 7 Fig, 8 Ref.

Descriptors: *Hydrologic models, *Hydrographs, *Infiltration, Model studies, Rainfall-runoff relationships, Runoff, Precipitation, *Green-Ampt equation, *Kostiakov equation, SMINF model, BLOINF model.

The infiltration equations of Green-Ampt and Kostiakov were used to determine the effective precipitation from a rainfall of non-constant intensity. These were tested in the SMINF and BLOINF hydrological models, respectively. Simulated hydrographs agreed well with observed discharges in two catchments of areas 4.6 and 363 sq km. In the larger, more heterogeneous catchment the INFAB 2 subroutine greatly underestimated the peak discharge. The INFAB 4 subroutine, which included interflow, improved the results substantially. (Cassar-FRC)
W83-01472

PHYSICAL CONTROLS OF WATER MOVEMENT IN THE UNSATURATED ZONE,
Institute of Hydrology, Wallingford (England).
S. R. Wellings, and J. P. Bell.
Quarterly Journal of EngineeringGeology, Vol 15, No 3, p 235-241, 1982. 6 Fig, 27 Ref.

Descriptors: *Hydrodynamics, *Fluid mechanics, *Soil Water, Groundwater movement, Aeration zone, Water flow, Physical properties.

Traditional hydrogeoglogical concepts of the unsaturated zone imply that the water is essentially static, and do not take into account the dynamic nature of the annual water cycle in the field. The basic concepts of water content, water potential and unsaturated hydraulic conductivity are defined as they are developed in soil physics and applied to the flow of water in the unsaturated zone. The emphasis is on a practical and non-numerical description of what happens in the field. An appreciation of the controls of water flow in the unsaturated zone is essential to an understanding of many hydrogeological problems. The water content and water potential profiles in the unsaturated zone are interrelated and almost always in a state of change. The water potential profile will constantly tend to move toward equilibrium with the water table. Attainment of the equilibrium is limited by decreasing unsaturated hydraulic conductivity, by inputs and outputs of water at the surface and by regional water table fluctuations. There are two main areas in which soil physical field investigations may be usefully and economically applied to the study of the unsaturated zone of soil and rock. The first is the measurement of the water balance of the profile, enabling actual evaporation and aquifer recharge to be measured. The second is the study of solute movement through the unsaturated zone. (Baker-FRC)
W83-01486

SORPTION AND MINERAL EQUILIBRIA CONTROLS ON MOISTURE CHEMISTRY IN A C-HORIZON SOIL,
Pennsylvania State Univ., University Park. Mineral Conservation Section.
For primary bibliographic entry see Field 2K.
W83-01495

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MEDIA IN RELATION TO THEIR GEOMETRICAL CHARACTERISTICS,
Institut National de la Recherche Agronomique, Tunis (Tunisia).
C. Laroussi, T. Touzi, and L. W. De Backer.
Soil Science, Vol 132, No 6, p 387-393, December 1981, 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Porous media, *Particle size, *Mathematical equations, *Permeability coefficient, *Hydraulic permeability, Hydraulic properties, Capillary water, Pore size, Particle shape, Mathematical studies, Porosity.

It is usually accepted that the hydraulic conductivity of saturated porous media (K) is a function of the geometrical characteristics of the solid matrix. Equations were established to relate K to geometry. Uniform glass beads of average diameters equaling, 150, 300, 600, or 1000 microns and narrow range sand fractions with diameters of 142.5, 180.0, 225.0, 282.5, 357.5 or 450 microns were used to determine their saturated hydraulic conductivity in a Darcy's permeameter. A linear relation with a null intercept was found between K and the mean diameter of the particles. In another set of experiments, mixtures of as many as five fractions were tested to obtain a large statistical distribution of particles. Another linear relation between K and the square of the mean diameter was obtained with an intercept (2) different from zero. It was established that the intercept b is a linear function of the square of the primary diameter. Using the b intercept, a new expression for K was formulated which holds true in the case of narrow fractions as well as for mixtures of fractions. (Geiger-FRC)
W83-01694

PENETRATION COEFFICIENT IN POROUS MEDIA,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
R. S. Malik, C. Laroussi, and L. W. De Backer.
Soil Science, Vol 132, No 6, p 394-401, December, 1981. 5 Fig, 3 Tab, 25 Ref.

Descriptors: *Porous media, *Hydrodynamics, *Capillary water, *Permeability coefficient, *Infiltration, *Capillarity, *Soil water, *Mathematical studies, Porosity, Pores, Condensation, Adsorption, Fluid mechanics, Permeability, Hydraulic permeability, Particle size.

In the case of horizontal infiltration in an air-dry soil with a zero hydrostatic head, the penetration coefficient is defined as the distance of advance of the visible wetting front per square root of unit time. Infiltration experiments were conducted in 53- to 63-micrometer, 74- to 88-micrometer, and 105- to 125-micrometer glass bead fractions with 100% water, 6 and 20% ethyl alcohol-water solutions, 100% ethyl alcohol and 100% methyl alcohol. The penetration coefficient of a porous media is composed of vapor penetration and a capillary coefficient. Liquid infiltration is a two-phased mechanism involving adsorption of fluid particles from the vapor phase by condensation on the solid matrix to form a liquid film and movement of fluid particles in the liquid phase primarily by capillary forces. Poiseuille's law governed the penetration of water but not other liquids in porous media. For uniform capillary tubes, the shape factor (G) was found to be much greater than 8. These findings provide a basis for applying capillary tube models to the study of hydrodynamics in porous media. (Geiger-FRC)
W83-01695

AN APPROXIMATE INTEGRAL SOLUTION OF VERTICAL INFILTRATION UNDER CHANGING BOUNDARY CONDITIONS,
Mississippi Univ., University. Dept. of Civil Engineering.
S. N. Prasad, and M. J. M. Romkens.
Water Resources Research, Vol 18, No 4, p 1022-1028, August, 1982. 2 Fig, 25 Ref.

Descriptors: *Infiltration, *Ponding, *Soil water, Boundary conditions, *Richards equation, Rainfall infiltration, Saturated zone, Wetting front, Vertical infiltration, Runoff.

An approximate analytical solution of the Richards Equation was derived for rain infiltration into a dry noncrusting semi-infinite homogeneous profile. The two-part solution was developed from a truncated spectral series expansion. The first part described the early stages of rainfall when infiltration is governed by a flux controlled boundary condition. The second part described infiltration after ponding, when a concentration boundary condition applies. During the second stage a flux matching boundary condition described the movement of the interface between the saturated and unsaturated zones. The solutions produced a general expression for ponding time, wetting front advance, and soil water profile. (Cassar-FRC)
W83-01714

PORE VELOCITY ESTIMATION UNCERTAINTIES,
Battelle Pacific Northwest Labs., Richland, WA.
J. L. Devary, and P. G. Doctor.
Water Resources Research, Vol 18, No 4, p 1157-1164, August, 1982. 16 Fig, 23 Ref.

Descriptors: *Estimating, *Pore water, *Velocity, *Waste disposal, Leaching, Infiltration, Model studies, Hydrology, Statistical analysis, Hazardous waste, Groundwater pollution, Stochastic hydrology, Parametric hydrology, *Washington, Hanford Reservation.

Geostatistical data analysis techniques were used to stochastically model the spatial variability of groundwater pore velocity in a potential water repository site. Kriging algorithms were applied to Hanford Reservation data to estimate hydraulic conductivities, hydraulic head gradients, and pore velocities. A first-order Taylor series expansion for pore velocity was used to statistically combine hydraulic conductivity, hydraulic head gradient, and effective porosity surfaces and uncertainties to characterize the pore velocity uncertainty. Use of these techniques permits the estimation of pore velocity uncertainties when pore velocity measurements do not exist. Large pore velocity estimation uncertainties were found to be located in the region where the hydraulic head gradient relative uncertainty was maximal. (Baker-FRC)
W83-01736

2H. Lakes

HYDROLOGY OF LAKE TOHOPEKALIGA, OSCEOLA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-01405

STRUCTURE AND COMPOSITION OF FLOODED SOILS OF THE KREMENCHUG RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
B. I. Novikov.
Hydrobiological Journal, Vol 17, No 4, p 75-79, 1981. 2 Tab, 13 Ref.

Descriptors: *Flooding, *Sediments, *Reservoirs, Kremenchug Reservoir, *USSR, Bottom sediments, Nutrients, Phosphorus, Sand, Loam, Soil types, Floods, Calcium, Magnesium, Carbon, Nitrogen.

Changes in the top 10 cm of flooded soils are determined, based on data obtained by the analysis of the structure and chemical composition of flooded soils of the Kremenchug reservoir and of soils surrounding it. After an initial significant migration of nutrient elements and organic substances into the water, which is typical of the first year

after flooding, exchanges between water and soil continue and result in a considerable increase in nutrients and some other elements in flooded soils. (Baker-FRC)
W83-01428

SUCCESSIONAL PATTERNS OF PLANTS, INVERTEBRATES AND DUCKS IN A MAN-MADE LAKE,
Sveriges Lantbruksuniversitet, Umea. Dept. of Wildlife Ecology.
K. Danell, and K. Sjoberg.
Journal of Applied Ecology, Vol 19, No 2, p 395-409, August, 1982. 8 Fig, 2 Tab, 55 Ref.

Descriptors: *Succession, *Lakes, *Wildlife habitats, *Ducks, Plants, Invertebrates, *Sweden, Water chemistry, Ecology, Acidity, Vegetation, Population dynamics, Potassium, Conductivity, Chemical oxygen demand, Sulfates, Sodium, Nutrients, Veittijarvi Lake.

A study was made of secondary successions in a shallow man-made lake of 35 ha, which was created in order to increase the local duck populations. Successional patterns were followed in water chemistry, in the vegetation and in the populations of vertebrates and ducks between the third and eighth years after flooding. The Veittijarvi lake is situated in the far north-eastern corner of Sweden. Water pH, conductivity, K, Na and SO4 contents in the lake outflow were higher than in the inflow. The chemical oxygen demand of the central lake water was negatively correlated with lake age. The number of macrophytic species increased, and the dominant submerged hydrophyte increased its coverage from a few percent to about 30% between 1971 and 1979. The Chironomidae were early colonizers, but between the third and eighth years the autumnal larval biomass decreased from 55 g per sq m to less than 10 g. Mean individual larval weight also decreased. During the years studied no linear change in the species diversity of ducks was recorded. Peak numbers of ducks occurred in the fourth and fifth years after flooding. Thereafter they decreased. Duck production values paralleled the changes in value of their main food items. The last finding stresses the importance of the early secondary successional stages, which provide an abundance of duck food at the right time of the season. (Baker-FRC)
W83-01433

THE ENRICHMENT OF A MESOTROPHIC LAKE BY CARBON, PHOSPHORUS AND NITROGEN FROM THE CAGE AQUACULTURE OF RAINBOW TROUT, SALMO GAIRDNERI,
Lodz Univ. (Poland). Inst. of Environmental Biology.
For primary bibliographic entry see Field 5C.
W83-01434

ZOOPLANKTON COMMUNITIES OF A NEW PUMPED STORAGE RESERVOIR,
New Mexico Environmental Improvement Agency, Santa Fe.
D. U. Potter, and J. L. Meyer.
Water Resources Bulletin, Vol 18, No 4, p 635-642, August, 1982, 9 Fig, 5 Tab, 37 Ref.

Descriptors: *Zooplankton, *Reservoirs, *Water storage, Pumping, Chlorophyll, Copepeds, Cladocera, Lake Oconee, Rotifers, Population dynamics, *Georgia.

Zooplankton were sampled monthly for 16 months at three stations along a gradient from lotic to lentic conditions in Lake Oconee, Georgia, a new pumped storage reservoir. The data were evaluated in light of the reservoirs's early stage of development, the differences among stations and seasons, and of pumped storage operations. Colonization was rapid, and the zooplankton community was characterized by a high species diversity. About 40 rotifer species and 14 cladoceran genera were recorded. Zooplankton density varied along an environmental gradient from riverine to lentic conditions. Rotifer abundance varied from 10,000 to 1,000,000 individuals per cubic meter, with maxima in the summers. Copepod and cladoceran densities range from 1,000 to nearly 10,0000 individuals/cubic meter, with maxima for stations other than the dam being observed in the summer and early fall, but high values at the dam station occurred throughout winter of 1980. When pumped storage operations began in December of 1979, zooplankton densities increased at the dam station. Pumpback decreased the intensity of the environmental gradient from riverine to lentic conditions, and led to a more similar zooplankton community structure throughout the reservoir. (Baker-FRC)
W83-01475

GEOMETRIC VARIATIONS IN RESERVOIR WATER QUALITY,
Massachusettes Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-01481

LABORATORY EXPERIMENTS AS AN AID TO LAKE RESTORATION DECISIONMAKING,
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 5G.
W83-01507

RECONNAISSANCE WATER-BALANCE STUDY OF LAKE GREGORY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
C. E. McConaughy.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-367, June 1982. 21 p, 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Surface water, *Hydrologic budget, *Streamflow, *Mountain lakes, Data collections, Available water, Water supply, Water use, Precipitation, Evaporation, Small watersheds, Runoff, Discharge measurement, *California, Lake Gregory, San Bernardino County.

A study was made to determine the magnitude and distribution of the surface-water inflow and outflow (water balance) of the Lake Gregory basin in southern California. Data were collected from April 1979 through June 1981. Runoff during the study period varied greatly with the majority of inflow occurring between December and May of each year. During 1980 and 1981 (through July 1981) precipitation totals at Lake Gregory were the maximum and minimum for the 19-year period of record. The average annual precipitation for the 3-year period 1979-81 was 47.4 inches, almost 10 inches greater than the long-term average, 1962-81, of 37.8 inches. Surface-water runoff in the Lake Gregory basin is highly dependent on annual precipitation, and total outflow for the 1980 water year and partial total for the 1981 (through June) water year was 7,230 acre-feet and 400 acre-feet, respectively. (USGS)
W83-01512

RELATIONSHIPS BETWEEN PHYTOPLANKTON GROWTH RATES AND NUTRIENT DYNAMICS IN LAKE NORMAN, N.C.,
Duke Power Co., Huntersville, NC.
For primary bibliographic entry see Field 5C.
W83-01526

THE APPLICATION OF PREDICTIVE MATHEMATICAL MODELS OF RESERVOIR ECOLOGY AND WATER QUALITY,
Ceskoslovenska Akademie Ved, Prague. Inst. of Landscape Ecology.
M. Straskraba.
Canadian Water Resources Journal, Vol 7, No 1, p 283-318, 1982. 13 Fig, 58 Ref.

Descriptors: *Reservoirs, *Water quality, *Mathematical studies, *Model studies, Mathematical equations, Eutrophication, Hydrodynamics, *Czechoslovakia, Retention time.

The MIT hydrodynamic model is critically evaluated on the basis of its application to Czechoslovak reservoirs. It is used for recognizing the dominant variables determining reservoir hydrodynamics and understanding their influence: retention time, outlet level, and extinction coefficient. Two eutrophication models are confronted with data from Slapy Reservoir, Czechoslovakia: a simple (3 compartment) model, AQUAMOD 1, and a complex (31 compartment) model, CLEANER. The simple model gives results no less accurate than the extensive model. A simple model is then used to understand the effect of inflow nutrient concentration, hydraulic loading, morphometry and light on phytoplankton. Based on AQUAMOD 1, a dynamic management optimization model including 5 control variables is developed, and first numerical experiences are reported. The notion of ecosystems as self-optimizing systems is summarized, and some numerical solutions are reported. The notion is extended to dynamic interactions between man and nature. (Baker-FRC)
W83-01542

ZOOPLANKTON POPULATION DYNAMICS DURING AND AFTER IMPOUNDMENT IN A SMALL RESERVOIR (JAMES BAY, QUEBEC),
Centre de Recherches Ecologiques de Montreal (Quebec).
B. Pinel-Alloul, E. Magnin, G. Codin-Blumer, and P. Ross.
Canadian Water Resources Journal, Vol 7, No 1, p 168-188, 1982. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Zooplankton, *Population dynamics, *Reservoirs, Lakes, Nutrients, Seasonal variations, Pumpback, Drawdown, Oxygen consumption, Decomposing organic matter, Quebec, James Bay, Desaulniers Reservoir.

An analysis was made of seasonal depth distribution of zooplankton during the first two years of impoundment of a small subarctic reservoir on the eastern shore of James Bay. After impoundment, 46 zooplankters were found, rotifers being numerically dominant in both years. Rotifer community composition was quite different between the first and second years. Polyarthra vulgaris and Keratella cochlearis were the most abundant species in 1977, while Conochilus unifornis and K. cochlearis dominated in 1978. Depth-time distributions of the principal species of Rotifera, Copepoda and Cladocera are described. Correlation between abundance of principal rotifers and biological factors such as density of other zooplankters, and abiotic factors such as temperature and oxygen tension, is tested. It was concluded that the zooplankton species assemblage found in Desaulniers Reservoir was similar to those of natural lakes of the region. The population dynamics could not be explained entirely by processes that occur in natural lakes. Pumpback, drawdown, nutrient leaching and oxygen consumption from plant decomposition may also play key roles. The virtual disappearance of Cladocera at the end of the second post-impoundment summer and the overriding importance of Rotifera are topics needing further study. (Baker-FRC)
W83-01543

AN EXTENDED CHANNEL MODEL FOR THE PREDICTION OF MOTION IN ELONGATED HOMOGENEOUS LAKES. PART 3, FREE OSCILLATIONS IN NATURAL BASINS,
Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. Raggio, and K. Hutter.
Journal of Fluid Mechanics, Vol 121, p 283-299, 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Channels, *Model studies, *Mathematical equations, Wave motion, Hydrodynamics, Hydrology, Basins, Lakes, Lake of Lugano, Coriolis force, *Switzerland.

The extended channel model as derived and analyzed in earlier publications is further developed by investigating free oscillations in natural enclosed basins. First, a zero-order model is analyzed. In this model, field variables are expressed as a product of a single known cross-sectional

shape function and an unknown function of time and the coordinate along the lake axis. Conditions are discussed under which this zero-order model is meaningful, and it is shown that under normal circumstances Coriolis effects must be ignored. Subsequently the general Nth-order channel model is applied to the Lake of Lugano. It is demostrated that eigenfrequencies and amphidromic systems are well predicted in such channel-like lakes. The paper concludes with a discussion on the selection of shape functions and with further applications and limitations of the channel model. (Baker-FRC)
W83-01544

AN EXTENDED CHANNEL MODEL FOR THE PREDICTION OF MOTION IN ELONGATED HOMOGENEOUS LAKES. PART 2. FIRST ORDER MODEL APPLIED TO IDEAL GEOMETRY: RECTANGULAR BASINS WITH FLAT BOTTOM,
Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. Raggio, and K. Hutter.
Journal of Fluid Mechanics, Vol 121, p 257-281, 1982. 9 Fig, 21 Ref.

Descriptors: *Model studies, *Hydraulics, *Lakes, Channels, Hydrodynamics, Wave motions.

A first-order channel model for fluid motion in long homogeneous lakes is presented. This model describes the motion through spatially one-dimensional boundary-value problems and is deduced by representing each field variable by cross sectional expansions with a constant and a linear term. Various wave solutions of the governing equations applied to rectangular basins with flat bottom are presented. It is demonstrated that for moderate rotation speeds of the Earth and for elongated basins of a homogeneous fluid the main features of gravitational oscillations are predicted by the model. In particular Kelvin- and Poincare-type waves are shown to exist. Furthermore, conditions of complete and incomplete reflections of Kelvin waves and free oscillations are discussed. The results corroborate the suitability of the model as far as wave motion in rectangular basins is concerned, but also elucidate the physics behind them, which would be less readily understood on application of the full theory. (Baker-FRC)
W83-01545

AN EXTENDED CHANNEL MODEL FOR THE PREDICTION OF MOTION IN ELONGATED HOMOGENEOUS LAKES. PART 1. THEORETICAL INTRODUCTION,
Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. Raggio, and K. Hutter.
Journal of Fluid Mechanics, Vol 121, p 231-255, 1982. 3 Fig, 39 Ref.

Descriptors: *Mathematical equations, *Model studies, *Lakes, *Hydraulics, Hydrodynamics, Channels.

A hydrodynamic model is developed, taking into account the slenderness of many lakes. The three-dimensional differential equations are formulated in a curvilinear coordinate system along the long axis of the lake. By applying the method of weighted residuals and expanding the field variables with shape functions over the cross sections, approximate equations for the fluid motion are derived. The emerging equations form a cross-sectionally discretized set of spatially one-dimensional partial differential equations in the longitudinal lake direction. First, these channel equations are presented for unspecified fluid properties and arbitrary shape functions, leaving applications possible for inviscid or viscous fluids with arbitrary closure conditions. The channel equations are subsequently specialized for Cauchy series as shape functions. For the free oscillation the simplest channel model is shown to reduce to the classical Chrystal equation. A first-order linear channel model is deduced. It exhibits the essential features of gravitational oscillations in rotating basins, in that it provides wave-type solutions with the characteristics of Kelvin and Poincare waves. The derivation of the equations is presented. (Baker-FRC)
W83-01546

RELATIONSHIPS BETWEEN LAKE RESERVOIR MANAGEMENT AND AMBIENT NUTRIENT CONCENTRATIONS IN LAKE OKEECHOBEE, FLORIDA,
South Florida Water Management District, West Palm Beach.
For primary bibliographic entry see Field 5G.
W83-01550

AN EMPIRICAL ANALYSIS OF PHOSPHORUS, NITROGEN, AND TURBIDITY EFFECTS ON RESERVOIR CHLOROPHYLL-A LEVELS,
For primary bibliographic entry see Field 5C.
W83-01551

THE APPLICATION OF PHOSPHORUS LOAD-TROPHIC RESPONSE RELATIONSHIPS TO RESERVOIRS,
Canadian Wildlife Service, Halifax (Nova Scotia).
J. J. Kerekes.
Canadian Water Resources Journal, Vol 7, No 1, p 349-354, 1982. 1 Tab, 9 Ref.

Descriptors: *Reservoirs, *Phosphorus, *Trophic level, *Eutrophication, Vollenweider equations, Nutrients, Physical properties.

Analysis of data obtained in the OECD Cooperative Program on Monitoring of Inland Water (Eutrophication Control) indicates that data from several of the 126 bodies of water studied do not fit the Vollenweider type nutrient load-nutrient concentration and trophic response, empirical relationships. Those which did not fit were long or narrow reservoirs where the in-lake concentration of total phosphorus was estimated based on measurements near the outflow, and thus it was not representative for the entire body of water. This misrepresentation of the average in-lake concentration may be corrected if the reservoir is treated as a series of connecting individual bodies of water, where each segment would fit the empirical phosphorus loading relationships. (Baker-FRC)
W83-01552

USE OF PHOSPHORUS BUDGET MODELS IN RESERVOIR MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W83-01553

MODELLING NITRATE CONCENTRATION IN SOME UNITED KINGDOM RESERVOIRS,
Water Research Centre, Slevenage (England).
For primary bibliographic entry see Field 5B.
W83-01554

INFLUENCE OF ADDED NUTRIENT ON THE SEASONAL VARIATION OF ALGAL GROWTH POTENTIAL OF MT BOLD RESERVOIR, SOUTH AUSTRALIA,
Adelaide Univ. (Australia), Dept. of Botany.
For primary bibliographic entry see Field 5C.
W83-01590

THOUGHTS ON USING THE RESULTS OF THE OECD-MONITORING PROGRAM IN LAKE PROTECTION (GEDANKEN ZUR UBERTRAGUNG DER ERGEBNISSE DES OECD-UNTERSUCHUNGS-PROGRAMMES IN DIE PRAXIS DES SEENSCHUTZES),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W83-01599

MODELING THE ANNUAL THERMAL REGIME OF LAKE OHRID, YUGOSLAVIA, USING DAILY WEATHER DATA,
Michigan Univ., Ann Arbor. Dept. of Geography.
S. I. Outcalt, and H. L. Allen.
Ecological Modelling, Vol 15, No 2, p 165-184, March, 1982. 7 Fig, 1 Tab, 16 Ref.

Descriptors: *Thermal stratification, *Numerical analysis, *Mathematical models, *Weather, *Lakes, Model studies, Simulation analysis, Solar radiation, Cloud cover, Air temperature, Humidity, Wind velocity, *Yugoslavia, Lake Ohrid.

The nature of daily weather variation and the performance of an improved version of the lake thermal model originally described by Outcalt and Allen were investigated as part of cooperative research program on Lake Ohrid, Yugoslavia. Five weather variables which control annual thermal response - solar radiation, air temperature, humidity, wind speed and cloud cover - were studies for time-dependence in a simple numerical model of thermal response forced by thermally driven density mixing. Comparisons with observed thermal profiles showed that the numerical model successfully simulates the major features of the lake's thermal regime over a 6 year period from 1972 to 1977. For this profile period, the average root mean square value was 1.2 degrees, extremes were 0.3 and 2.2 degrees, and standard deviation was 0.4 degrees. (Geiger-FRC)
W83-01664

SOME EFFECTS OF LANGMUIR CIRCULATION ON THE QUALITY OF WATER RESOURCE SYSTEMS,
Prince of Songkla Univ. (Thailand). Dept. of Civil Engineering.
T. Buranathanitt, D. J. Cockrell, and P. H. John.
Ecological Modelling, Vol 15, No 1, p 49-74, February, 1982. 11 Fig, 28 Ref.

Descriptors: *Lakes, *Reservoirs, *Mathematical models, *Suspended solids, *Sedimentation, *Water quality, Advection, Diffusion coefficient, Diatoms, Mathematical studies, Mathematical equations, Particle size, *Langmuir circulation.

The quantitative extent to which the large-scale organized water motion in the surface water of lakes and reservoirs (Langmuir circulation) affects the distribution and settling of algae and other suspended particles was modelled mathematically. The water quality model was based on a two-dimensional advection-diffusion mass transport equation describing the temporal and spatial distribution of suspended particles in a typical Langmuir cell. The Langmuir circulation flow field and turbulent diffusion coefficients are modelled in relation to environmental parameters. Results indicated that a particle distribution and settling are not affected by Langmuir circulation, except for particles of high sinking velocity, where aggregation may give rise to significant reductions in sinking loss when compared with that predicted by conventional models. For diatoms, reductions of 6% or more may occur, depending on which conventional model is used, while for sand and silt particles in a cell of large width-to-depth ratio, a reduction of over 60% is possible. (Geiger-FRC)
W83-01666

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS, PORE WATER AND THE AMPHIPOD PONTOPOREIA HOYI FROM LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W83-01742

2I. Water In Plants

ENVIRONMENTAL AND PHYSIOLOGICAL CONTROL OF WATER FLUX THROUGH PINUS-CONTORTA,
Montana Univ., Missoula. School of Forestry.
S. W. Running.
Canadian Journal of Forest Research, Vol 10, No 1, p 82-91, March, 1980. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Water potentials, *Conductance, *Humidity, *Pine trees, *Diurnal distribution,

*Seasonal variation, *Correlation analysis, *Soil-water-plant relationships, Radiation, Air temperature, Conifers, Mathematical studies, Soil water, Water transport, Soil water potential, *Colorado, Fraser Experimental Forest.

Measurements of leaf conductance, leaf water potential, temperature, humidity, and radiation were taken on a stand of Pinus contorta Dougl. ex Loud lodgepole pine during one growing season at the Fraser Experimental Forest in Colorado. Attempts were made to quantitatively relate diurnal and seasonal changes in leaf conductance to the measured parameters and compare the results with those of other western conifers. From June through August, the daily range of leaf conductances decreased ten-fold. A high correlation was found between predawn leaf water potential and morning maximum leaf conductance. Midday leaf conductance was significantly less when atmospheric humidity was low. The present finding showed good agreement with results of studies on other conifers. A nonlinear correlation was found between seasonal changes in total soil-plant resistance to water flux and changes in predawn leaf water potential. (Geiger-FRC)
W83-01537

MANAGEMENT OF TRICKLE IRRIGATED ORCHARDS FOR INCREASED WATER-USE EFFICIENCY, VOL. 1: PLANT RESPONSES OF DRIP IRRIGATED TREES TO CLIMATE AND WATER STRESS,
Texas Water Resources Inst., College Station.
J. F. Punthakey, M. J. McFarland, P. B. Rodrugue, and J. W. Worthington.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150086, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No 120 - Vol 1, August 1982, 142 p, 12 Tab, 49 Fig, 64 Ref. OWRT B-241-TEX(2), 14-34-0001-0252.

Descriptors: *Evapotranspiration, *Trickle irrigation, Lysimeter, Water balance, *Peach orchards, Water use, Irrigation design, Heat pulse velocity, Stephenville, *Texas, *Leaf water potential, *Water stress.

Past irrigation research has shown that peach trees vary in their field response to water stress, and the degree of stress is a function of the plants' environment. This research examined the effect of environmental variables on leaf water potential, leaf resistance, canopy resistance and transpiration rate, and evaluated their ultimate effect on yield, water use efficiency and pruning weights for trees under four drip irrigation regimes at Stephenville, Texas. Treatments selected were instrumented with 1-, 2-, 3- and 4- emitters per tree, and single trees from each treatment were instrumented with ground covers. Plant responses were measured hourly on sunlit and shaded leaves of each treatment. Leaf water potentials and leaf resistances were higher in shaded leaves, resulting in reduced transpiration. An increase in early morning leaf water potentials indicated irrigation had decreased stress. Lower leaf water potentials and higher leaf resistance indicated the trees were being severely stressed prior to harvest. Leaf water potentials decreased linearly, whereas leaf resistance decreased exponentially, with increasing solar radiation. In stressed trees critical leaf water potentials were lower suggesting some degree of adaption to stress. Leaf water potentials decreased linearly with increasing transpiration. Total resistance (sum of plant an soil resistance) increased with increasing severity of stress. The 3-emitter tree was recommended, since yield and water use efficiency are relatively high. Proper irrigation increased total yields and also the number of fruit within a marketable size range, while maintaining high water use efficiency, resulting in economic benefits to the farmer.
W83-01577

SIMULATION OF THE REVEGETATION POTENTIAL OF COAL MINES IN SEMI-ARID CLIMATES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
J. W. Franklin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150193 Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis 1981, 92 p, 10 Tab, 24 Ref, 3 Append. OWRT B-073-ARIZ(3).

Descriptors: *Revegetation, *Mine wastes, *Soil banks, *Simulation, *Soil water, *Semiarid lands, Coal mines, Computer models, Irrigation, Land reclamation, Drought, Rainfall, Germination.

A computer model was developed to predict the success or failure of revegetating mine spoils. The model consists of a stochastic rainfall model coupled to a soil moisture model which is used to predict if there is sufficient moisture for plant growth. The parameters which affect the revegetative process were then varied to study their impact. The stochastic rainfall model was developed from data from the Betatakin Ruins (Arizona) which was then matched to hypothetical distributions in order to more easily recreate the rainfall patterns of the area. Using the model for a one year period, it was seen that the most limiting parameter is the amount of soil moisture that is available for the germination process. An irrigation model was also run to see the effect of adding extra moisture. Very little moisture would need to be added to get established in each year. Using the model for a ten year period indicated that without irrigation in the first year, there was very little chance for successful revegetation. With irrigation in the first year, the plants would have to withstand moderate to long droughts. It is felt that the Federal law that governs revegetation can be met, even in an arid climate, if the species which are to be planted are selected for the area, the soil moisture holding capacity is increased, and irrigation is applied in the first year. (Moore-SRC)
W83-01611

RESPONSE OF FOUR GRAIN LEGUMES TO WATER STRESS IN SOUTH-EASTERN QUEENSLAND. II. PLANT GROWTH AND SOIL WATER EXTRACTION PATTERNS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
R. J. Lawn.
Australian Journal of Agricultural Research, Vol 33, No 3, p 497-509, 1982. 3 Fig, 6 Tab, 8 Ref.

Descriptors: *Water stress, *Plant growth, *Crop yield, Queensland, *Australia, Soil water, Water extraction, Moisture availability, Moisture stress, Rainfall, Dehydration, Drought, Soybeans, Black grams, Green grams, Cowpeas.

Growth and water use of soybean, black gram, green gram and cowpea in response to water stress were evaluated in the field at Dalby in southeast Queensland. Differing strategies of growth and water use which reflected the differential expression of dehydration avoidance and developmental plasticity in response to stress were identified among species. The primary difference between strategies related to differences in dehydration avoidance. Soil water extraction during the initial phases of drought was faster, and leaf area development and plant growth were relatively less affected in soybean than in the Vigna spp. Where adequate soil water existed, these differences were sustained during the drought period but were reversed where soil water was limited. Soil water extraction by soybean occurred to greater depths and to lower potentials than in the Vigna spp. Developmental plasticity influenced growth pattern in the Vigna spp. to varying degrees. Drought periods invariably curtailed growth and hastened maturity in green gram and black gram, but rain prior to maturity induced renewed growth in black gram. Moderate stress curtailed growth and hastened maturity in cowpea, which also responded to late rains with renewed growth. Severe stress inhibited growth and delayed development in cowpea indefinitely. (Baker-FRC)
W83-01690

SPRUCE PLANTATION EFFECTS ON SOIL MOISTURE AND CHEMICAL ELEMENT DISTRIBUTION,
Morton Arboretum, Lisle, IL.
A. S. Messenger.
Forest Ecology and Management, Vol 3, No 2, p 113-125, 1980, 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Forest management, *Soil water, *Soil properties, *Soil-water-plant relationships, *Spruce trees, *Fertility, Soil moisture deficiency, Soil horizons, Soil profiles, Soil physical properties, Soil chemistry, Soil types, Hardwood.

Opinions are still varied on whether or not spruce has a favorable effect on soil fertility. This problem was studied by collecting data on several and semi-static soil properties in a 48-year-old mixed spruce plantation and comparing them with soil properties of the surrounding hardwood forests with the same soil types. During May, the surface soil was drier in the spruce plantation, however, the B horizon of the spruce forest was significantly moister than that of the hardwood forests from late spring to fall. In mid-June, the calcareous C horizon of the spruce plantation dried out rapidly until late summer. The surface soil of the spruce stand was significantly more acidic and contained higher levels of extractable manganese than the hardwood forest surface soil, possibly due to differential biocycling intensities. The soil types studied are well suited to Picea abies. It is suggested that one rotation of Picea abies intermixed with Picea pungens may render the soil more suitable for species which would otherwise be hindered by a less acid surface soil and a dense, calcareous C horizon. (Geiger-FRC)
W83-01691

RESPONSE OF FOUR GRAIN LEGUMES TO WATER STRESS IN SOUTH-EASTERN QUEENSLAND. III. DRY MATTER PRODUCTION, YIELD AND WATER USE EFFICIENCY,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia), Div. of Tropical Crops and Pastures.
For primary bibliographic entry see Field 3F.
W83-01692

2J. Erosion and Sedimentation

MAPPING SOIL EROSION BY RAINFALL FOR REGIONAL ENVIRONMENTAL PLANNING,
Sheffield Univ. (England). Dept. of Geology.
D. J. Briggs, and J. France.
Journal of Environmental Management, Vol 14, No 3, p 219-227, May, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Maps, *Soil erosion, Erosion, Universal soil loss equation, South Yorkshire, *England, Rainfall, Land use, Erosion control.

Variations in erosion due to land use practices must be known in order to plan and assess erosion control measures. The universal soil loss equation was used to develop a method for estimating annual soil loss through rainfall erosion in South Yorkshire, England. The resulting semiquantitative estimates of erosion were plotted on a 1 km grid square map of the county. Only a few areas experience significant soil losses under present agricultural systems. These areas are located in the western section of the county where steep slopes are cultivated, overgrazing has occurred on peatland interfluves, and heather is burned. The slight erosion problems in the east central part of the county are associated with escarpments of magnesian limestone where concave-convex slopes, intensive cultivation, and fine soils combine to produce localized erosion. (Cassar-FRC)
W83-01412

STABILITY OF BEDFORMS IN A TIDAL ENVIRONMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
G. A. Zarillo.
Marine Geology, Vol 48, No 3/4, p 337-351, 1982. 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Sand waves, *Dunes, *Ripples, *Sediment transport, Tidal effects, Bedforms,

Sapelo Island, *Georgia, Duplin River, Megaripples, Wavelengths, Wave height, Ebb tides, Flow power, Shear velocity, Water depth, Particle size, Estuaries, Bed shear.

Large-scale bedforms were investigated in the Duplin River, a tidal estuary in Sapelo Island, Georgia. Two distinct forms were discerned: megaripples, also called dunes (4-15 m wavelength and 10-75 cm high) and sand waves (15-45 m wavelengths and 85-130 cm high). The sand waves existed in megarippled and smooth-crested forms. The large-scale bedforms maintained an ebb-oriented geometry through both ebb and flood parts of the tidal cycle. Bedforms were in equilibrium with peak tidal flow, and ebb orientation was the direct result of large pressure gradients and bed-shear values which developed during the ebb. Bedform heights were dependent on flow power, shear velocity, water depth, and sediment grain size, but were not dependent on mean flow velocity. The significant parameters were used to construct bivariate plots showing separate stability fields of sand waves and megaripples. The megaripples formed at smaller flow depths and lower flow power values than sand waves. The megarippled sand waves formed in areas of coarser sand, and smooth-crested sand waves in finer sands. (Cassar-FRC)
W83-01430

THE LOCH EIL PROJECT: SIMULATION OF THE HYDROLOGY AND SEDIMENT INPUTS TO LOCH EIL,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W83-01441

SPATIAL AND TEMPORAL VARIABILITY IN SUSPENDED SEDIMENT YIELDS OF NORTH ISLAND BASINS, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths.
Water Resources Bulletin, Vol 18, No 4, p 575-584, August, 1982. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Suspended sediments, *River basins, *Variability, Spatial distribution, Distribution, Temporal distribution, *New Zealand, Climate, Precipitation.

Suspended sediment yields and their standard errors are reported for rated North Island basins, to provide empirical prediction equations of known precision. Most of the variance in yields found for the 47 basins is explained by catchment mean rainfall. Rivers with similar flow range had similar suspended sediment concentration ratings, independent of differing watershed lithology and regolith, except for six basins having an abundance of soft fine sediments. Prediction equations for yield and its standard deviation are derived for four essentially arbitrary regions. All feature rainfall as the independent variable. Differences between regions may be due to their variations in intensity, frequency, and duration patterns of storms and, in one area, to bed material size as well. The temporal distribution of annual yields from a basin can be modeled by a two parameter lognormal function: the prediction equations may be used to evaluate this function at a site for which suspended sediment data are not available. (Baker-FRC)
W83-01477

SEDIMENTATION IN AN ARID-ZONE ANASTOMOSING FLUVIAL SYSTEM: COOPER'S CREEK, CENTRAL AUSTRALIA,
Ottawa Univ. (Ontario). Dept. of Geology.
B. R. Rust.
Journal of Sedimentary Petrology, Vol 51, No 3, p 745-755, September, 1981. 11 Fig, 2 Tab, 26 Ref.

Descriptors: *Sedimentation, *Fluvial sediments, *Petrology, Lake Eyre Basin, *Australia, Channels, Alluvial channels, Alluvial deposits, Sedimentary petrology, Arid zone, Channel morphology, Sand.

Cooper's Creek is one of several extensive fluvial systems in the Lake Eyre Basin of Central Australia. It has a wide variety of channels, largely multiple. The large extent and aggradational regime of the system make it a suitable model for interpreting ancient successions formed under similar environmental conditions. The dominant channel pattern is a combination of relict braids and active anastomosing channels. The braids are the partly buried surface expressions of a sand sheet attributed to a pluvial episode about 5,000 years ago, whereas the anastomosing pattern is interpreted as an adjustment to the present arid climate. Tectonism and eolian processes are minor, localized influences. The anastomosing channels accumulate sand, but they occupy a small part of the floodplain, on which overbank mud is blanketing the relict braids. A preliminary depositional model for arid-zone anastomosing fluvial systems compromises a mud-dominated succession, with minor isolated channel sands. Other features are deep desiccation cracks, minor carbonaceous horizons, duricrusts, and evaporite horizons. (Baker-FRC)
W83-01488

FLUME EXPERIMENTS ON LOWER-FLOW-REGIME BED FORMS IN COARSE SAND,
Esso Resources Ltd., Calgary (Alberta).
W. R. Costello, and J. B. Southard.
Journal of Sedimentary Petrology, Vol 51, No. 3, p 849-864, September, 1981. 8 Fig, 2 Tab, 32 Ref.

Descriptors: *Sedimentary petrology, *Flume, Channels, *Sand, Dunes, Sediments, Sedimentation, Petrology, Currents, *Bedforms.

Attempts were made to refine the picture of hydraulic relationships among the various kinds of bed configurations. A large number of flume runs were made covering the range of sand sizes from about 0.5 mm to about 0.8 mm in which ripples are known to give way to flat-bed transport with increasing sand size. Greatest emphasis was placed on geometry and mechanics of dunelike bed forms, with the aim of establishing a better basis for comparison between the laboratory bed forms and the large-scale bed forms developed in the same ranges of sand size and current velocity in deeper natural flows. A plot of mean flow velocity versus sand size for all the runs shows that at low flow velocities the ripple field narrows with increasing sand size and pinches out at about 0.7 mm. The field for flat bed transport narrows with decreasing sand size and pinches out at about 0.5 mm, just above the ripple field. At high field velocities, dunes are the stable phase for all sand sizes studied. Dune configurations are divided into two subphases. Two-dimensional dunes with fairly straight, continuous, even crests and no strong localized scour in troughs are formed at relatively low flow velocities. Three-dimensional dunes with strongly sinuous, discontinuous, uneven crests and strong, localized scour pits in troughs are formed at relatively high flow velocities. In both geometry and hydraulic relationships both types of dunes in the flume runs corresponded to the relatively regular megaripples at low flow velocities and relatively irregular megaripples at high flow velocities described by other authors from intertidal environments. (Baker-FRC)
W83-01489

SEDIMENT TRANSPORT AND EFFECTIVE DISCHARGE OF THE NORTH PLATTE, SOUTH PLATTE, AND PLATTE RIVERS IN NEBRASKA,
Geological Survey, Denver, CO., Water Resources Div.
J. E. Kircher.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price $3.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-53, 1981. 26 p, 16 Fig, 3 Tab, 11 Ref.

Descriptors: River, South Platte River, Platte River.

Sediment discharge was computed for four locations along the North Platte, South Platte, and the Platte Rivers between North Platte and Grand Island, Nebraska in order to determine the effective discharge. The total-sediment discharge was computed by the Colby method and modified Einstein method so that comparisons could be made with the measured total-sediment discharge. The results agreed closely. The Colby method is the simplest and most convenient to use. The mean annual total-sediment discharge for the four sites investigated ranged from 150 tons per day for the South Platte River at North Platte to 1,260 tons per day for the Platte River near Grand Island. The effective discharge at the sites ranged from 41 to 158 cubic meters per second. The probability of the effective discharge being equaled or exceeded ranged from 1 to 30 percent for the four sites. (USGS)
W83-01517

STABILITY OF ARMOUR LAYERS IN RIVERS,
Auckland Univ. (New Zealand). Dept. of Civil Engineering.
A. J. Raudkivi, and R. Ettema.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 9, p 1047-1057, September, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Sediment transport, *River beds, *Entrainment, *Armor layers, Bed load, Embedding, Particle size, Bottom sediments.

The influences of overpassing and embedding of river bed particles were studied in a 456 mm wide flume. The stability of a single-layer-thick layer of armoring particles on a bed of smaller uniform particles is characterized by the tendency of the larger particles to overpass or become embedded into the bed surface. Between overpassing and embedding there is a transition region in which the larger particles cannot overpass a bed surface under flows that do not entrain the smaller bed particles. The ability of these flows to embed the larger particles into the surface increases with the value of the ratio of diameter of larger particles to diameter of smaller particles. Armor layers composed of particles which embed are more stable than layers which tend to overpass. (Cassar-FRC)
W83-01548

RESISTANCE TO FLOW IN ALLUVIAL CHANNELS,
Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
G. Holtorff.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 9, p 1010-1028, September, 1982. 7 Fig, 17 Ref.

Descriptors: *Sediment transport, *Flow resistance, *Channel morphology, Bed load, Antidunes, Bars, Ripples, Dunes, Alluvial channels, Froude number, Wavelengths, Friction loss, Suspended load, Suspended sediments, Rivers.

A theory is derived for predicting the geometry of bed patterns in alluvial channels and evaluating the influence of the sediment transport rate on flow resistance. Bed patterns include ripples, dunes, antidunes, and bars. Several conclusions were reached. For steady flow the bed forms assume a stable form. The friction factor due to form resistance is related to the height and, to a lesser degree, the length of bed forms. Ripples and bars do not depend on the Froude number but on the friction factor. Dunes depend on both the Froude number and friction factor. Antidunes depend only on the Froude number. Flow can produce ripples superimposed on dunes. The work rate of the fluid is reduced as the work rate of the transported sediment increases. Under steady conditions of water and sediment discharge, the suspended load has no direct effect on size and formation of bed waves. However, heavy suspended loads can reduce flow resistance. Data in published literature from flume experiments and the Missouri River agree reasonably well with the theoretical curve. (Cassar-FRC)
W83-01549

BANK STABILITY AND CHANNEL WIDTH ADJUSTMENT, EAST FORK RIVER, WYOMING,

Geological Survey, Lakewood, CO.
E. D. Andrews.
Water Resources Research, Vol 18, No 4, p 1184-1192, August, 1982. 7 Fig, 26 Ref.

Descriptors: *Channel morphology, *Sediment transport, *Stream erosion, Bank stabilization, Bank erosion, Erosion, East Fork River, *Wyoming, Scour, Fill, Sand, Parker model, Aggradation, Degradation, Stream banks, Bankfull stage, Channel accretion, Channel erosion, Channel scour, Streambeds.

Relationships between channel morphology and scour and fill were studied in the East Fork River, Wyoming, a sinuos stream with prominent sandy point bars and well-developed pool and riffle sequences. Surveys during the 1974 snowmelt period showed that reaches with cross sections narrower than the mean reach width filled at discharges less than bankfull and scoured at discharges greater than bankfull. Conversely, the cross sections wider than the mean reach width scoured at discharges less than bankfull and filled at discharges greater than bankfull. Sediment was not scoured and filled evenly across the channel. Depletion and accumulation was concentrated in the near bank parts of the channel. Bank stability and retreat depended significantly on whether sediment was deposited or removed at the base of banks at discharges greater than bankfull. In the cross sections which scour at discharges greater than bankfull bank erosion occurred. Conversely, in cross sections which fill discharges greater than bankfull, the bank material, covered by sandy deposits, was not eroded. Channels narrower than the mean reach width had steep sides; channels wider than the mean reach width had gently-sloping sides. A resurvey in 1980 showed that cross sections which scoured at discharges greater than bankfull had widened by 2-4 ft; the cross sections which filled at discharges greater than bankfull had not changed. Results of this study tentatively support Parker's (1978) model of channel width adjustment by a sand bed stream. (Cassar-FRC)
W83-01729

2K. Chemical Processes

QUALITY OF STREAMS IN THE BULL MOUNTAINS REGION, SOUTH-CENTRAL MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
J. R. Knapton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-238361, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-2, 1982. 50 p, 5 Fig, 9 Tab, 21 Ref.

Descriptors: *Surface water, *Water quality, *Streams, *Baseline studies, Coal mines, Streamflow, Runoff, Baseflow, Water analysis, Anions, Cations, Dissolved solids, Sediment load, Nutrients, Trace elements, *Montana, Bull Mountains, Musselshell River.

In October 1977, water-quality monitoring stations were established on five small streams that drain the Bull Mountains and also on the Musselshell River to document present water-quality conditions in a coal area of south-central Montana. Relatively static water-quality conditions exist throughout the annual flow cycle on the small streams but water quality varies with time on the Musselshell River. The near absence of surface runoff in the Bull Mountains during the study and the dominance by the base-flow component account for stability of water quality in the small streams. High-mountain runoff coupled with storms and prairie runoff impact the base flow of the Musselshell River. Bicarbonate and sulfate were the principal anions and are present in nearly equal proportions in all small streams. Except for West Parrot Creek, magnesium was the most dominant cation. West Parrot Creek, which consistently contained the smallest levels of dissolved solids, had sodium rather than magnesium as the principal cation. Fattig Creek was highest in dissolved solids with an approximate concentration range of 900 to 2,100 milligrams per liter. Suspended-sediment discharge in the streams was relatively small; no stream exceeded 0.32 ton per day. The Musselshell River had dissolved solids concentrations that ranged from about 450 milligrams per liter during spring runoff to 1,800 milligrams per liter during periods of base flow. The sodium sulfate-type water, which is common during base flow, is diluted during runoff with water having principal ions of calcium, magnesium, and bicarbonate. Suspended-sediment loads ranged from 0.56 to 37,300 tons per day and correlated directly to stream discharge. (USGS)
W83-01407

THE LOCH EIL PROJECT: EFFECT OF ORGANIC MATTER INPUT ON INTERSTITIAL WATER CHEMISTRY OF LOCH EIL SEDIMENTS,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5B.
W83-01440

THE LOCH EIL PROJECT: CHLOROPHYLL A AND NUTRIENTS IN THE WATER COLUMN OF LOCH EIL,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 2L.
W83-01442

ISOTOPE GEOCHEMISTRY OF DISSOLVED, PRECIPITATED, AIRBORNE, AND FALLOUT SULFUR SPECIES ASSOCIATED WITH SPRINGS NEAR PAIGE MOUNTAIN, NORMAN RANGE, N.W.T.,
National Hydrology Research Inst., Calgary (Alberta).
R. O. van Everdingen, M. A. Shakur, and H. R. Krouse.
Canadian Journal of Earth Sciences, Vol 19, No 7, p 1395-1407, July, 1982. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Sulfur cycle, *Springs, *Geochemistry, Isotopes, Sulfur compounds, Paige Mountain, *Northwest Territories, Gypsum beds, Spring water, Sulfates, Chemical analysis, Chemical properties.

Present understanding of the system of sulfur transformations associated with a group of strongly sulfurous springs located near Paige Mountain in the Northwest Territories has been enhanced through total 0-18 and total S-34 measurements made on oxidized sulfur species in the system. Total S-34 values determined for disssolved sulfate in water discharged in the sulfurous springs identify gypsum beds in the Lower Devonian Bear Rock Formation as the sulfate source, whereas relatively low 0-18 values show that as much as 30% of the sulfate may have gone through a reduction-reoxidation cycle. Reduced sulfur species in the spring water have negative S-34 values as a result of microbiological isotope fractionation during sulfuric reduction; airborne sulfur species and gypsum formed through reaction of sulfuric acid fallout with exposed carbonate rocks show similar negative S-34 values. Negative 0-18 values for the sulfate radical in sulfuric acid fallout and in the alteration product indicate that more than half of the oxygen reacting with airborne hydrogen sulfide is derived from water vapor. (Baker-FRC)
W83-01487

SORPTION AND MINERAL EQUILIBRIA CONTROLS ON MOISTURE CHEMISTRY IN A C-HORIZON SOIL,
Pennsylvania State Univ., University Park. Mineral Conservation Section.
S. O. Sears, and D. Langmuir.
Journal of Hydrology, Vol 56, No 3/4, p 287-308, April, 1982. 3 Fig, 3 Tab, 53 Ref.

Descriptors: *Chemical reactions, *Minerals, *Sorption, Recharge, Soil water, Acid rain, Precipitation, Equilibrium, Soil horizons, Vadose water, *Pennsylvania, Hydrogen ion concentration, Dissolved solids, Ion exchange, Adsorption.

The chemistry of soil moisture was studied in central Pennsylvania sandy loam soils over a 12 month period. The dolomite bedrock depth was 6-14 m, and depth to the water table was 60-90 m. A total of 146 samples were collected at 1-9 m depths with suction lysimeters. The soil moisture chemistry was described by Ca > Na > Mg = K and bicarbonate > chloride > sulfate = nitrate. pH was 5.20 - 6.74. Dissolved silica was 15-117 (average 54) mg per liter as Si02. Specific conductance varied from 20 to 400 micro S per cm. Total dissolved solids in the soil water increased with decreasing precipitation and increasing temperature. This was a result of evapotranspiration, which concentrated the salts in the soil water, reduced soil relative permeabilities, and increased the contact time between minerals and water. The increased acidity of precipitation in warmer months and drier periods also contributed to the increase in total dissolved solids. Water chemistry was not controlled by the solubility equilibria involving calcite, dolomite, quartz, amorphous silica, and the illite-kaolinite reaction. Regression analysis of dissolved ion activities showed that the cations were strongly buffered by Donnan equilibrium, with selective adsorption in the order K > H > Mg > Ca. Soil moisture was underestimated with respect to quartz and probably kaolinite. Sorption equilibria actively controlled major cation concentrations at all depths of the soil. Solution-mineral equilibria did not limit the cation concentration. Continued buildup of dissolved species and a solubility equilibrium are prevented by the short residence time of the water in the C horizon. (Cassar-FRC)
W83-01495

WATERSHEDS IN MUSKEG TERRAIN. 2. EVALUATIONS BASED ON WATER CHEMISTRY,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, and W. A. Milne-Home.
Journal of Hydrology, Vol 57, No 3/4, p 291-305, June, 1982. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Muskeg, *Chemical composition, *Streamflow, Environmental effects, Geochemistry, Geohydrology, Surface water, Groundwater, Runoff, Water quality , Snowmelt, Surface mining, Baseflow, Watersheds, Wetlands, Surface-groundwater relations, *Alberta, Muskeg River, Hartley Creek, Thickwood Creek, Firebag River, Steepbank River, Seasonal variation, Glacial drift.

Information on water chemistry in muskeg terrain, obtained in previous studies of the Muskeg River and Hartley Creek basins, Alberta, was extended to nearby Firebag River, Steepbank River, and Thickwood Creek. The region contains vast quantities of oil sands which are mined from the surface. All basins are covered with glacial drift underlain with Precambrian to Cretaceous bedrock. Groundwater from the glacial drift is the major source of streamflow in winter in all the basins. During spring and summer, drainage from the muskeg is the most important contributor (50-90%) to streamflow. If surface mining in these basins replaces the muskeg with mineral soil, stream discharges will be lower in summer and higher during spring snowmelt and storm runoff periods. Major ion concentrations will be less dilute in summer and fall. Upstream storage in lakes and ponds and mixing with waters from other parts of the basin would mitigate the effects of muskeg disturbance. (Cassar-FRC)
W83-01497

A MODEL FOR STREAMWATER CHEMISTRY AT BIRKENES, NORWAY,
Central Inst. for Industrial Research, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W83-01733

2L. Estuaries

AN INVESTIGATION OF THE DISSOLVED FREE AMINO ACIDS AND THEIR RELATION TO PHYTOPLANKTON CELL DENSITY IN

THE DAMARISCOTTA RIVER ESTUARY, MAINE,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
S. A. Macko, and E. J. Green.
Estuaries, Vol 5, No 1, p 68-73, March, 1982. 4 Fig, 23 Ref.

Descriptors: *Amino acids, *Phytoplankton, *Nutrients, Estuaries, Salinity, Temperature, Water temperature, Chlorophyll, Silicates, Nitrates, Phosphates, Damariscotta River, *Maine.

Total dissolved free amino acids were directly related to individual amino acid variations and not to the other variables measured: salinity, temperature, phytoplankton nutrients, chlorophyll, and cell counts. Dissolved free amino acids levels in the Damariscotta River Estuary, Maine, varied between about 100 and 300 nM per liter over the period January 1975-January 1976. This suggested that removal of the amino acids, either by organisms or adsorption, was continuous and rapid. In prediction of cell density, only silicate and chlorophyll were significant predictors. (Cassar-FRC)
W83-01426

STABILITY OF BEDFORMS IN A TIDAL ENVIRONMENT,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2J.
W83-01430

THE LOCH EIL PROJECT: SEDIMENT CHEMISTRY, SEDIMENTATION AND THE CHEMISTRY OF THE OVERLYING WATER IN LOCH EIL,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5B.
W83-01439

THE LOCH EIL PROJECT: CHLOROPHYLL 'A AND NUTRIENTS IN THE WATER COLUMN OF LOCH EIL,
Dunstaffnage Marine Research Lab., Oban (Scotland).
B. Grantham.
Journal of Experimental Marine Biology and Ecology, Vol 55, No 2/3, p 283-297, 1981. 9 fig, 1 Tab, 26 Ref.

Descriptors: *Nutrients, *Chlorophyll a, *Phytoplankton, Estuaries, Loch Eil, *Scotland, Runoff, Rainfall, Brackish water, Phosphates, Nitrates, Ammonia, Fjords.

Loch Eil, Scotland, receives a small amount of fresh water from streams and a much greater amount of brackish water at the seaward end of its mouth from Loch Linnhe through Annat Narrows. Compared with Loch Creran, which has similar fresh water input and dimensions, Loch Eil has a lower standing crop of phytoplankton, higher light attenuation from humic compounds, and a deeper surface mixed layer. Loch Eil's unusual hydrography causes surface chlorophyll a values to be closer to those of Lakes receiving high runoff. Water chemistry parameters measured at three Loch Eil stations and one station at Lynn of Lorne (control) during 1976-77 were: dissolved inorganic phosphate, < 0.03 - 0.91 microgram-atoms phosphate-P per liter; dissolved inorganic nitrate, < 0.5 - 8.4 microgram-atoms nitrate-N per liter; ammonia, < 0.1 - 2.8 microgram-atoms ammonium-N per liter; and chlorophyll a, 0.05 - 5.46 mg per cu m. There were some differences in nutrient levels between the control and Loch Eil. Eil had greater stratification and ammonia concentrations and lower nitrate levels than the Lynn of Lorne. Phosphate and nitrate minima in the surface water occurred in May in Eil but not until June in Lynn. Deep water minima were recorded later in the summer. Ammonia levels in deep water were highest in Eil during April-November and in Lynn during March-September. (Cassar-FRC)
W83-01442

THE AMERICAN OYSTER AS A COASTAL ZONE POLLUTION MONITOR: A PILOT STUDY,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 5A.
W83-01444

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WATER IN ESTUARIES OF TEXAS, OCTOBER 1976-SEPTEMBER 1978,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-01514

PHYSICAL, HYDROLOGICAL, AND BIOLOGICAL CHARACTERISTICS OF THE LOXAHATCHEE RIVER ESTUARY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W83-01518

FOULING COMMUNITY DYNAMICS IN LYNNHAVEN BAY, VIRGINIA,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
C. M. Otsuka, and D. M. Dauer.
Estuaries, Vol 5, No 1, p 10-22, March, 1982, 5 Fig, 4 Tab, 36 Ref.

Descriptors: *Fouling, *Invertebrates, *Population dynamics, Lynnhaven Bay, *Virginia, Estuaries, Barnacles, Species distribution, Macroinvertebrates, Predation, Hydroids, Polychaetes, Tunicates, Molgula.

Dynamics of the fouling community was studied on the undersurface of smooth white acrylic panels in Lynnhaven Bay, Virginia Beach, Virginia, where mean salinity was 22.9 o/oo. Early colonization, similar on panels immersed in April 1977 and in April 1978, was initiated by hydroids, barnacles, and Polydora ligni. Molgula manhattensis, a solitary tunicate, colonized a week later and rapidly overgrew all species but Balanus eburneus. Exclusion panels, protected from predation in hardware cloth cages, had significantly greater abundances of Sabella, Botryllus, and Microconia and significantly fewer Hydroides than control panels. Molgula was also the dominant species on the exclusion panels, coexisting underneath other species. Removal of the protective cages in May 1978 caused a slough-off of Botryllus and Sabella and an increase in Molgula and Micronia. Species numbers were significantly greater on panels with larger surface areas (225 sq cm vs. 1 and 25 sq cm). Larger panels were generally colonized by a species a week or more before the same species was evident on smaller panels. (Cassar-FRC)
W83-01578

TEMPORAL PATTERNS IN THE STRUCTURE OF MACROBENTHIC COMMUNITIES OF AN AUSTRALIAN ESTUARY,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries and Oceanography.
S. Rainer.
Estuarine, Coastal and Shelf Science, Vol 13, No 6, p 597-620, December, 1981, 4 Fig, 7 Tab, 53 Ref.

Descriptors: *Estuarine environment, *Temporal distribution, *Stress, *Benthos, *Australia, Population dynamics, Distribution, Intertidal areas, Biomass.

The benthic fauna of a small estuary was examined to test hypotheses about community structure and environmental stress. Quantitative samples were collected at about 2-mouth intervals over 18 months from Cabbage Tree Basin, Port Hacking, New South Wales. The sites sampled ranged from the intertidal to a central basin subject to deoxygenation of the bottom water. The species composition of the intertidal and shallow-water sites was more stable than that of the deeper sites, due to the presence of short-lived opportunistic species at the deeper sites after periods of deoxygenation. No changes directly associated with reduced salinity after rainfall were noted, although heavy rainfall prior to the sampling period may have reduced the number of species at some sites. The stable community structure and species composition at the intertidal and shallow-water sites indicated that greater environmental harshness does not necessarily imply less faunal stability. Differences in diversity among these sites were interpreted as evidence that biological accomodation was responsible for a reduction in diversity from values predicted by the neutral model. At a deeper site, diversity was close to neutral model predictions. It is suggested that the ecotone point in a stressed community may be characterized by diversity values that are in agreement with neutral model predictions. The statistical properties of the measures of diversity and evenness were not important for their interpretation. Biomass-based measures indicated patterns that were often different from frequency-based measures. (Baker-FRC)
W83-01579

GROUNDWATER-LEVEL VARIATION DURING SEMIDIURNAL SPRING TIDAL CYCLES ON A SANDY BEACH,
Wollongong Univ., (Australia) Dept. of Geography.
For primary bibliographic entry see Field 2F.
W83-01587

DYNAMICS OF CARBON AND NITROGEN DURING THE DECOMPOSITION OF DETRITUS DERIVED FROM ESTUARINE MACROPHYTES,
State Univ. of New York at Binghamton.
D. L. Rice, and K. R. Tenore.
Estuarine, Coastal and Shelf Science, Vol 13, No 6, p 681-690, 1981. 4 Fig, 2 Tab, 48 Ref.

Descriptors: *Estuarine environment, *Nutrients, *Detritus, Macrophytes, Decomposition, Decomposing organic matter, Carbon, Nitrogen, Algae, Sea grasses, Mangrove swamps, Marsh plants.

Laboratory investigations were conducted into chemical fluxes associated with the decomposition of detritus derived from nine species of estuarine macrophytes representing a wide variety of initial compositions and four types of detritus-based ecosystems: salt marsh, seagrass, seaweed and mangrove. Decomposition is defined as transformation from solid matter to dissolved matter rather than simple reduction to some critical particle size. Experiments were conducted using a flow through system to ensure a continuous supply of dissolved nutrients but preventing loss of detritus particles, wave action and invasion by macrofauna. After 150 days of aging, red algal detritus had lost about 65% of its original organic content; mangrove and seagrass detritus lost about 20%, while brown algal detritus lost quantities intermediate between these two extremes. There was a continuous efflux of carbon from all detritus. Beginning with 10 g of each detritus, initial rates of carbon efflux ranged from 40 to 60 mg C/day, but after the initial leaching period, C efflux dropped to 2-6 mg C/day. Red algal detritus continuously lost nitrogen during decomposition, initially at a rate of 6 mg N/day, and 0.60 mg N/day after initial leaching. After a brief period of nitrogen leaching, vascular plant detritus increased in absolute nitrogen content at rates of 0.11 to 0.31 mg N/day. All macrophyte detritus types are sources of carbon to estuarine waters. Decay-resistant vascular plant detritus may be a nitrogen sink to the sediments unless recycling by detritivores and benthic regeneration conserves nitrogen for re-use in the ecosystem. (Baker-FRC)
W83-01595

ORGANIC CARBON TRANSPORT IN THE COLUMBIA RIVER,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5B.
W83-01596

PLUTONIUM AND AMERICIUM EXPORT TO THE NORTH-EAST PACIFIC OCEAN BY COLUMBIA RIVER RUNOFF,
Oregon State Univ., Newport. Marine Science Center.
For primary bibliographic entry see Field 5B.
W83-01597

CONSERVATIVE BEHAVIOUR OF DISSOLVED LITHIUM IN ESTUARINE WATERS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
P. Stoffyn-Egli.
Estuarine, Coastal and Shelf Science, Vol 14, No 5, p 577-587, May, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Estuarine environment, *Lithium, *Geochemistry, Estuaries, *St. Lawrence River, *Scheldt River, Belgium, Water analysis, Mixing, The Netherlands, Canada.

The concentration and distribution of dissolved lithium in the St. Lawrence River estuary (Canada) and the Scheldt River estuary (Belgium and the Netherlands) have been investigated. Vertical water column samples were collected at 26 stations. Dissolved Li was conservative in the St. Lawrence estuary. The data points all plot close to the dilution line, and the regression line through the data points practically coincides with the dilution line. In the case of the Scheldt estuary most data points also plot on a straight line, but this line does not coincide with the dilution line. The fact that the data points plot above the dilution line is explained only by the existence of an input of dissolved Li into the estuarine waters. Because the data points plot on a straight line for salinities below 25 o/oo the distribution of dissolved Li in that part of the Scheldt River estuary must be the result of physical mixing between river water and an intermediate end-member of approximately 25 o/oo salinity and containing 153 to 161 micrograms Li/liter. It is probable that the dissolved Li distribution at salinities higher than 25 o/oo is also determined by purely physical mixing of the intermediate end-member and seawater. The intermediate end-member must be caused by a very localized input of dissolved Li. This excess Li was carried downstream without much mixing with seawater in May, whereas admixture of seawater diluted the excess Li during the June survey. The most likely cause of a localized input of Li in the Scheldt estuary would be man-made, very probably from the industrial activity in the area. (Baker-FRC)
W83-01598

THE THREE-TROPHIC LEVEL ESTUARINE MODEL: SYNERGISM OF TWO MECHANISTIC SIMULATIONS,
University of Southern California, Los Angeles. Dept. of Biological Sciences.
J. N. Kremer, and P. Kremer.
Ecological Modelling, Vol 15, No 2, p 145-157, March, 1982. 6 Fig, 27 Ref.

Descriptors: *Estuaries, *Carnivores, *Model studies, *Nutrients, *Biomass, *Trophic level, *Bays, Ecology, Ecosystems, Estuarine environment, Zooplankton, Phytoplankton, Dynamics, Simulation, *Rhode Island, Narragansett Bay.

In estuarine trophic models, extensive mechanistic detail for important carnivores is often hard to simulate due to the lack of reliable and relevant ecological data for appropriate species of local populations. Also, the wide temporal and spatial differences between the life histories of lower plankton and carnivores may be difficult to model. Some of these problems are overcome in a detailed carbon-based simulation model using the ctenophore, Mnemiopis leidyi, of Narragansett Bay, Rhode Island. The model was developed independently from an ecosystem model which featured interactions between phytoplankton and nutrients. Combining the two models allowed the practice of forcing certain components to be tested. Both models were originally constructed with the biomass of critical compartment forced according to observed data. In the combined model, predicted biomasses for zooplankton and ctenophores were similar to the results of the two parent models, but showed improvements in terms of actual field observations. (Geiger-FRC)
W83-01662

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

LOWER NET PRESSURE REVERSE OSMOSIS MEMBRANES AND SYSTEMS-COST AND PERFORMANCE ADVANTAGES AND LIMITATIONS,
S. S. Kremen, M. Jhawar, and C. E. Hull.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150375, Price codes: A06 in paper copy, A01 in microfiche. Report, June 1982, 107 p, 3 Fig, 20 Tab, 5 Ref, 1 Append. OWRT C-00180-D(No 0491)(1), 14-34-0001-0491

Descriptors: *Reverse osmosis, *Membrane processes, *Desalination, *Cost analysis, Computer models, Seawater, Brackish water, Energy costs.

Reverse osmosis systems are generally designed and utilized on the basis of reference membrane water flux and desalting performance at 400 psi net driving pressure (NDP). Membranes now being offered and tested at a preliminary commercial stage are capable of equivalent performance at 200 psi NDP. These membranes offer immediately obvious savings in energy costs for reverse osmosis desalting and water reclamation. In addition, they can make a most important contribution to reduced membrane replacement costs and improved permeate quality when operating on high salinity feeds at higher recovery levels. Significant initial and midlife reverse osmosis performance improvements and cost reductions have been projected by computer for a wide range of brackish feed salinities over a representative range of temperatures at two pressure levels using low pressure membranes, compared to standard pressure membranes. Savings in system equipment, components and membrane element materials and assembly costs may be expected to yield small economic benefits compared to energy cost and membrane replacement cost savings, particularly when the systems are operated with low pressure elements at 350 psig under brackish feed conditions. A number of hypothetical cases were developed and tabulated, assuming a 200 psi NDP sea water membrane was available. Substantial benefits could be expected if such a membrane could be developed and reduced to practice. Additional cost savings and performance improvements can be realized by operating the 200 psi NDP membranes at somewhat higher applied pressures which preserve or enhance NDP. (Moore-SRC)
W83-01612

THE EVALUATION OF SELECTED FREEZE DESALTING PILOT PLANTS FOR SUITABILITY AND POTENTIAL INTEREST FOR FURTHER COMMERCIAL DEVELOPMENT,
Burns and Roe Industrial Services Corp., Oradell, NJ.
For primary bibliographic entry see Field 6C.
W83-01629

HOW TO SOLVE SOLID WASTE AND DRINKING WATER PROBLEMS SIMULTANEOUSLY,
Kuljian Corp., Melbourne, FL.
R. E. Bailie.
American City and County, Vol 97, No 9, p 28-31, September, 1982. 1 Fig, 1 Tab

Descriptors: *Desalination, *Solid wastes, *Reverse osmosis, Water quality, Water supply development, Seawater, Brackish water, Advanced wastewater treatment, Drinking water, Water treatment facilities.

When a resource recovery system has proved itself a success, it has at least one ingredient in common with all other similar successes. This component is close cooperation with a long term purchaser of the energy produced by the facility. Salt water intrusions into the aquifers that serve large populations on both Florida coasts and along the Eastern seaboard have degraded drinking water supplies. Many of these problems can be eased by advanced water treatment technology, particularly desalination processes. Attempts to link solid waste energy recovery with desalination for fresh water production for fresh water production began in the early 1960s. The first success story of a combined effort was America's first steam-producing refuse incinerator, a waterwall type installed in Long Island. The facility produced 325 psi steam that was totally used by in-plant equipment. Analyzing the numerous false starts in the joint solid waste/desalination projects suggests that the desalination technology that fits neatly with modular incineration is reverse osmosis (RO). If an inflation-proof source of electric power were available to a planned RO facility, it would greatly alleviate the justifiable concerns over this technology's high energy consumption. (Baker-FRC)
W83-01667

TESTING THE MEMBRANE PLUGGING FACTOR IN REVERSE OSMOSIS,
Neptune Microfloc, Inc., Corvallis, OR.
D. Comstock.
Journal of the American Water Works Association, Vol 74, No 9, p 486-490, September, 1982. 13 Fig, 6 Tab, 3 Ref.

Descriptors: *Membrane processes. *Reverse osmosis, *Filtration, Water treatment, Plugging factor test, Silt density index test, Organic matter, Seawater, Flow resistance, *Desalination.

The theory behind the silt density index test (also known as the plugging factor test), widely used as a predictor of feed water quality for reverse osmosis, was studied. In most cases plugging of membrane filters was caused by particles in the filtered suspension blocking the filtration process. Organic molecules were an important factor in seawater processes. Plugging factor data from a previous study of groundwater and seawater were evaluated in terms of a mathematical expression for the resistance of a blocked filter. Laboratory filtration tests with plastic microspheres showed that particles of the same cross sectional area as the membrane filter pores were most effective in blocking filtration. The plugging factor correlated well with flow resistance across membrane filters. (Cassar-FRC)
W83-01669

3B. Water Yield Improvement

STATE OF MONTANA ACTIVITIES IN THE HIGH PLAINS COOPERATIVE PROGRAM: 1975-1980,
Montana Dept. of Natural Resources and Conservation, Helena.
G. M. Knudsen, and R. M. Moy.
Final Report, April 1981. 292 p, 49 Fig, 55 Tab, 306 Ref, 1 Append. 14-06-D-7577.

Descriptors: *Weather modification, *Precipitation, *Environmental effects, *Public participation, *Montana, Simulation, Wind erosion, Grasslands, Vegetation, Rain gages, Pests.

Efforts of the State of Montana in the Miles City area of eastern Montana which pertain to the High Plains Cooperative Program (HIPLEX) of Project Skywater are reported. Activities dealing with meteorological aspects of the program included: (1) establishment and operation of raingage networks and collection of precipitation data; (2) acquisition and reduction of certain weather radar data; (3) evaluation of raingages, raingage networks and rainfall data; (4) conduct of precipitation climatology studies; and (5) assisting with developmental, operational and analytical aspects of a portable automated weather station network. Associated impact assessment studies were conducted which were designed to estimate the potential effects of warm season weather modification on major eco-

systems of the Northern High Plains. Using treatments which simulated a range of potential precipitation regimes, assessments were made of: (1) grassland yield and quality responses: (2) potential invading plants; (3) invasion of pest species; (4) beneficial organism responses; (5) wind erosion; and (6) species composition. Activities need to facilitate public involvement in HIPLEX were maintained since the outset of the program. The nature and scope of these activities is discussed.
W83-01636

MALAYSIA MALAISIE.
Aqua, No 4, p 6-8, 1982. 3 Fig.

Descriptors: *Groundwater potential, *Drilling, *Deep wells, *Rural areas, *Water distribution, *Water supply development, Well casings, Well function, Test wells, Potable waters, Water resources development, Construction, *Malaysia.

A Malyaysian firm of engineers, a Malaysian contractor, and a British firm of consultants are working on a well drilling program to provide reliable water supplies to rural areas of Kedah and Perlis in Peninsular Mayaysia. During the day seasons in these areas, traditional water supplies are depleted. The government wants 250 tubewells installed over a 20 month period. Longer term projects will connect tubewells to an expanding surface water distribution network. Problems of obtaining the right equipment hampered drilling progress. Most of the wells tap shale and sandstone aquifers. Some limestone wells have already experienced brackish water intrusion. Assessment of water demands starts from villages listed by the Public Works Department (PWD) as being in need of groundwater supplies. Field surveys are done to find suitable drilling sites. Well accessibility is also taken into consideration. Drilling on private and agriculturally developed lands is avoided as much as possible. PVC pipe is used as a casing for each well, and each pair of pieces is joined by double ended sockets that are solvent-cemented together. Open hole construction is being adopted wherever possible, and air drilling is being used in all hard rock areas. Only selected representative wells will be tested for discharge, geometry and storativity. Delivery of potable water to rural areas will depend on PWD completion of distribution systems. (Geiger-FRC)
W83-01647

3C. Use Of Water Of Impaired Quality

AMINO ACIDS IN THE FOOD WEB OF A WASTEWATER AQUACULTURE SYSTEM FOR REARING JUVENILE SALMON,
Humboldt State Univ., Arcata, CA. Dept. of Biology.
W. V. Allen, and G. H. Allen.
Progressive Fish-Culturist, Vol 43, No 4, p 178-182, October, 1981. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Amino acids, *Fish food organisms, *Aquaculture, Wastewater treatment, Salmon, Aeration ponds, Invertebrates, Wastewater lagoons, Stabilization ponds, Ponds, Lagoons.

Total free amino acid levels in pond water (in mg per liter) and in crustaceans (in mg per 100 mg dry weight) from the Arcata, California, sewage treatment system and wastewater aquaculture ponds were: aeration pond, 3.27; oxidation pond, 0.33; unstabilized pond, 0.20; partly stabilized pond, 0.88; stabilized pond, 0.44; daphnia in oxidation pond, 25.99; Corophium spinicorne in stabilized pond, 21.80; Anisogammarus confervicolus in unstabilized pond, 17.62-22.93; and isopods in unstabilized pond, 9.07. Seventeen amino acids were identified in water and 20 in crustaceans. (Cassar-FRC)
W83-01425

3E. Conservation In Industry

REUSE AND DISPOSAL CONSIDERATIONS FOR HYPERFILTRATION CONCENTRATE,
Clemson Univ., SC.
For primary bibliographic entry see Field 5D.
W83-01501

3F. Conservation In Agriculture

OPTIMUM CROPPING AND GROUND WATER MANAGEMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
For primary bibliographic entry see Field 4B.
W83-01505

MANAGEMENT OF TRICKLE IRRIGATED ORCHARDS FOR INCREASED WATER-USE EFFICIENCY,
Texas Water Resources Inst., College Station.
M. J. McFarland, J. W. Worthington, J. F. Punthakey, and P. B. Rodrigue.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150078, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 120 - Summary Report, August 1982. 30 p, 2 Tab, 4 Fig, 28 Ref, Append. OWRT B-241-TEX(1), 14-34-0001-0252.

Descriptors: *Evapotranspiration, *Trickle irrigation, Lysimeter, Water balance, *Water use, *Irrigation design, Heat pulse velocity, *Peach orchards, *Texas, Irrigation scheduling.

Trickle irrigation is the most efficient method of irrigating peach orchards in Texas. With a trickle irrigation system, a producer may make full use of a limited or low-volume water supply to apply precise amounts of water to the root zones of individual trees. Improved irrigation scheduling methods offer the potential for further savings in water and energy to pressurize the water since peach trees require less than a fully-watered state for production. This report describes research to determine the crop coefficients for peach trees that would result in an optimum irrigation schedule. One major effort evaluated the physiological response of the peach tree to varying irrigation regimes. This thrust indicated that a crop coefficient as low as 0.53 produced similar physiological responses (leaf water potential, leaf resistance, and transpiration rate) as a crop coefficient of 0.7. The critical period for initiation of stress was during the period before harvest. A large twin weighing lysimeter facility was designed and installed. Preliminary results for mature peach trees showed water use rates at the maximum evapotranspiration rate approached a crop coefficient of 1.0. The research indicates that the peach tree is a luxury consumer of water; improved irrigation scheduling is achievable.
W83-01576

MANAGEMENT OF TRICKLE IRRIGATED ORCHARDS FOR INCREASED WATER-USE EFFICIENCY, VOL. I: PLANT RESPONSES OF DRIP IRRIGATED TREES TO CLIMATE AND WATER STRESS,
Texas Water Resources Inst., College Station.
For primary bibliographic entry see Field 2I.
W83-01577

MODEL TO EVALUATE CONSERVATION, DESIGN, AND ECONOMIC FEASIBILITY OF SUPPLEMENTAL IRRIGATION SYSTEMS IN THE SUB-HUMID REGION,
Water Resources Research Inst., Manhattan.
J. J. Zovne, O. H. Buller, and J. M. Steichen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150219, Price codes: A05 in paper copy, A01 in microfiche. Contribution No 225, September 1982, 73 p, 14 Fig, 36 Tab, 20 Ref, 2 Append. OWRT B-059-KAN(1), 14-34-001-9145

Descriptors: *Water supply, *Irrigation water, *Economic feasibility, *Hydrologic models, Climate, Watersheds, Soil water, Corn, Soybeans, Kansas, Ponds, Storage reservoirs, Mathematical models, Water conservation.

The risk of water supply failure for supplemental irrigation systems, where water supply is surface runoff stored in a reservoir, depends upon climate, supply watershed characteristics, the volume of the storage pond and the irrigated crop. In order to assess the joint probabilities involved, a continuous digital irrigation systems analysis and irrigation scheduling model has been developed. The hydrologic model presented consists of a watershed, pond, and one or more irrigation sites. The model generates yield to pond, assesses crop water needs, and actuates irrigation based on soil moisture depletion. Weather data input is from any nearby weather station in the Weather Bureau daily network which virtually allows the engineer to test any system in the U. S. Reliability curves for irrigating 57 ha of corn at various locations in eastern Kansas with various sizes of watersheds and reservoir volume are presented. An economic analysis of supplemental irrigation in eastern Kansas is presented. Cropping budgets are developed for several irrigated and dryland crops. Under present grain prices and production costs, nonirrigated grain sorghum has the highest return of all the crops studied. Any significant shift between cost of production and relative grain prices will place irrigated corn and soybeans in the highest net profit category.
W83-01614

RELATIONSHIP OF COSTS AND WATER USE EFFICIENCY FOR IRRIGATION PROJECTS IN IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
R. G. Allen, and C. E. Brockway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150391, Price codes: A14 in paper copy, A01 in microfiche. Idaho University Research Technical Completion Report, August 1979. 304 p, 12 Fig, 30 Tab, 26 ref, 8 Append. OWRT-B-039-IDA(3), 14-039-0001-7152.

Descriptors: *Irrigation operation and maintenance, *Irrigation efficiency, *Idaho, *Water delivery, Agriculture, Maintenance costs, Operating costs, Conveyance structures, Use rates, Percolation, Economic efficiency, Cost-benefit analysis, Snake River.

Cost information and water use data were collected for 17 irrigation projects in Idaho for the years 1974-1976. Major costs categories were administrative, water control, maintenance, power, water shortage, personnel, and vehicle maintenance and materials. The U. S. Bureau of Reclmation O and M indices were used to adjust all costs to 1977 price levels. Water diversions, deliveries, and losses were determined for 1977. All 17 of the projects studied, ranging from 2400 to 150,000 acres, get their water from the Snake River or its tributaries. Various costs ranges were found including $1.85-$61.30/irrigated acre for total project operating costs and $1.80-$12.80/irrigated acre for administration, water control, and maintenance. An irrigation efficiency range of 12% to 59% was found for 1977 operations. Study results show a highly significant relationship between selected operation and maintenance costs to water use data and a projects' physical characteristics. Water-use efficiency at all projects can be increased by decreasing water loss due to deep percolation and operational spillage. Overall management of the 17 projects is effective given the funds available. Farmers in project areas do not consider the benefits obtained from more effective use of the projects water sufficient enough to offset the high costs of more effective use. (Seigler-IPA)
W83-01637

YIELD AND GROWTH RESPONSES OF KENAF (HIBISCUS CANNABINUSL) IN A SEMI-ARID TROPICAL ENVIRONMENT TO IRRIGATION REGIMES BASED ON LEAF WATER POTENTIAL,
Commonwealth Scientific and Industrial Research Organization, Kununurra (Australia). Div. of Tropical Cropsand Pastures.
R. C. Muchow, and I. M. Wood.
Irrigation Science, Vol 1, No 4, p 209-222, 1980. 9 Fig, 2 Tab, 28 Ref.

Descriptors: *Water stress, *Semiarid climates. *Plant water potential, *Crop production, *Irrigation requirements, Pulp and paper industry, Water requirements, Tropic zone, Irrigation programs, Drought resistance, Irrigation practices, Plant growth, Water potentials, Irrigation efficiency, *Kenaf.

The growth response of kenaf to four irrigation schemes based on leaf water potential was examined in a semi-arid, tropical environment. In regimes in which the mean value of leaf water potential was greater than -1.26 MPa, total dry matter production was unaffected. Stem elongation was more sensitive than dry matter accumulation to water stress. The economic yield for pulp production increased with the frequency of irrigation. Relief of water stress 10 weeks after irrigation when leaf water potential was -1.60 MPa resulted in stem elongation rates greater than those of plants previously receiving irrigation. This suggests that kenaf has water stress response features which would make it suitable for production by rainfall alone under semi-arid tropical conditions. Irrigation programs based on leaf water potential successfully met crop water requirements because water use increased and the time interval between irrigations decreased with increasing canopy development as well as with increasing evaporative demand. However, this method is difficult to use due to erractic fluctuations in leaf water potential between irrigations. Also the use of daily mean dawn or noon values of leaf water potential for scheduling irrigation is not recommended under high evaporative demand conditions. (Geiger-FRC)
W83-01672

THE SENSITIVITY OF GROWTH AND YIELD OF DWARF WHEAT TO WATER STRESS AT THREE GROWTH STAGES,
Ahmadu Bello Univ., Zaria (Nigeria). Agronomy Section.
P. N. Choudhury, and V. Kumar.
Irrigation Science, Vol 1, No 4, p 223-231, 1980. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Wheat, *Water stress, *Crop yield, *Irrigation requirements, *Irrigation efficiency, Plant growth, Water requirements, Irrigation programs, Irrigation practices, Crop production, Pan evaporation, Drought resistance.

Field tests were conducted over two growing seasons to study the growth: seeding to maximum tillering, maximum tillering to flowering, and flowering to maturity. Plants were subjected to three different ratios of irrigation water to cumulative pan evporation (IW/CPE), 0.45, 0.60, and 0.75, at the different growth stages being tested. At all stages of growth, moderate and severe water stress decreased plant height, leaf area, ear number, 1000-grain weight, grain yield and water use efficiency. Wheat was most sensitive to water stress during the seeding to maximum tillering stage when the reduction in grain yield was caused by a reduction in number of ears and grains per ear. In the next growth stage, yield was reduced due to fewer grains per ear and lower 1000-grain weight. Medium stress plants showed complete recovery upon rewatering. Results suggest that when water is scarce, the wheat crop should be irrigated at an IW/CPE ratio of 0.75, and when water supply is unlimited, a ratio of 1.2 in stage 2 will maximize yield. (Geiger-FRC)
W83-01673

EFFECTS OF CLIMATE ON THE YIELD RESPONSE OF TWO FESCUE SPECIES TO WATER AND NITROGEN APPLICATION,
Institut National de la Recherche Agronomique, Paris (France).
S. Meriaux.
Irrigation Science, Vol 1, No 4, p 233-239, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Irrigation requirements, *Crop yield, *Nitrogen, *Air temperature, *Humidity, *Seasonal distribution, *Light intensity, *Forages, Irrigation efficiency, Irrigation programs, Plant growth, Water stress, Nutrients, Seasonal variation, Climates, Grasses, Correlation analysis, *France.

The effect of three climatic parameters - air humidity, air temperature, and number of hours of bright sunshine - and their interaction with water and nitrogen treatments on the monthly yield of dry matter by two species of fescue grass was examined in a replicated field experiment for four years. Yields from plots receiving weekly irrigation and the highest rate of nitrogen application were linearly correlated to the total number of hours of bright sunshine the plot received unless the minimum air humidity was below 40% and the maximum air temperature was > 26 degrees. Only the direct and interactive effects of water and nitrogen showed significance over a seasonal time scale. (Geiger-FRC)
W83-01674

WATER-CONSERVING WHEAT IRRIGATION SCHEDULES BASED ON CLIMATIC RECORDS,
Baylor Univ., Waco, TX. Dept. of Geology.
D. M. Greene, and M. B. Kirkham.
Irrigation Science, Vol 1, No 4, p 241-246, 1980. 2 Fig, 15 Ref.

Descriptors: *Irrigation efficiency, *Correlation analysis, *Wheat, *Crop yield, *Irrigation requirements, *Rainfall, Water requirements, Irrigation practices, Irrigation programs, Plant growth, Climatic data, Semiarid lands, Crop production, *Oklahoma.

Correlations were drawn between spring rainfall and grain yield for four cultivars of winter wheat grown between 1950 and 1977 under dryland conditions in Stillwater or Goodwell, Oklahoma. At Stillwater, most of the cultivars exhibited maximum positive correlations between rainfall and yield in the fourth week of March, when stem-extensions occur. In mid-April during flowering, small positive correlations were observed. At Goodwell correlations between rainfall and yield were lower and occurred earlier than at Stillwater and exhibited a less pronounced secondary peak at flowering. These findings suggest that both stem-extension and flowering ar critical stages of water requirement and that long-term climatic data could be used to determine optimum timing for irrigation of wheat. Such an approach should conserve water and energy by limiting irrigation to those periods demonstrated by local records to have the maximum positive correlations between rainfall and yield. (Geiger-FRC)
W83-01675

A PROCEDURE FOR MINIMIZING REQUIRED TUBEWELL CAPACITY IN IRRIGATED RICE,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Gupta, and N. K. Tyagi.
Irrigation Science, Vol 1, No 4, p 253-262, 1980. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Irrigation efficiency, *Mathematical models, *Rice, *Irrigation requirements, *Planting management, Mathematical studies, Rainfall, Available water, Irrigation water, Irrigation canals, Model studies, Crop production, Irrigation practices, *India.

A method of determining the peak tubewell capacity needed for irrigation of rice grown under shallow water submergence is presented. The mathematical formula incorporates both the effective rainfall and the available canal water supply while dividing the planting period into small sub-periods. Decision rules formulated outside of the model are used to determine the area to be planted in each sub-period. The model was applied to an area served by lateral canal in the Western Jamuna Canal Command. The recommended planting schedule involves reducing the peak tubewell capacity by about 25% over the existing capacity requirement. As a result of efficient use of the installed tubewell capacity, the cost of irrigation is decreased. (Geiger-FRC)
W83-01676

DROUGHT ADAPTATION OF COWPEA. IV. INFLUENCE OF DROUGHT ON WATER USE, AND RELATIONS WITH GROWTH AND SEED YIELD,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
K. J. Turk, and A. E. Hall.
Agronomy Journal, Vol 72, No 3, p 434-439, May-June, 1980. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Drought resistance, *Crop yield, *Water use, *Cowpeas, Water stress, Root development, Water use efficiency. Growth stages, Evapotranspiration, Evaporation, Pan evaporation, Irrigation practices.

Drought effects on cowpea crop water use and relations with growth and seed yield were studied during 1976 and 1977 in sandy loam fields at Riverside, California. Two powpea cultivars, 'California Blackeye No. 5', and 'Chino 3', were subjected to four different irrigation treatments using alinesource sprinkler system. Treatments were Io, the control, weekly irrigation; I1, no irrigation for 43 days during vegetative growth; I2, no irrigation for 32 days during flowering; and I3, no irrigation for 30-40 days during podfilling. Within each irrigation treatment four drought levels were maintained: wet, medium wet, medium dry, and dry. The seasonal patterns of the ratio of evapotranspiration (ET) to pan evaporation (E pan) were similar for both years, which had contrasting patterns of potential evapotranspiration. Under well-watered conditions, Et/E pan increased linearly with ground cover and had an average value of 0.94 with complete ground cover. Although ET was well below the potential level during different levels of drought and at different growth stages, it recovered rapidly following a vegetative-stage drought. When plant cover was not limiting, ET/E pan was extremely sensitive to percentage available water in the rooting zone; the threshold was 90%. There was a linear relationship between ET/E pan and fractional ground cover x available water. Root growth increased linearly through the season, reaching 135 cm depth under well-watered conditions or as little as 50 cm depth under driest conditions. A linear relationship was seen between relative seed yield and relative water use from early flowering to harvest. Water use efficiency generally increased with vegetative stage drought and decreased with late season droughts. (Cassar-FRC)
W83-01680

DROUGHT ADAPTATION OF COWPEA. II. INFLUENCE OF DROUGHT ON PLANT WATER STATUS AND RELATIONS WITH SEED YIELD,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
K. J. Turk, and A. E. Hall.
Agronomy Journal, Vol 72, No 3, p 421-427, May-June, 1980. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Drought resistance, *Water potential, *Irrigation practices, *Cowpeas, Water stress, Crop yield, Leaves, Sprinkler irrigation, Water loss, Growth stages, Pressure chamber.

The mechanisms of cowpea adaptation to drought and the relations between yield and plant water status were studied during 1976 and 1977 in sandy loam fields at Riverside, California. Two cowpea cultivars, *California Blackeye No. 5,' and 'Chino 3', were subjected to four different irrigation treatments using a line-source sprinkler system. Treatments were Io, the control, weekly irrigation; I1, no irrigation for 43 days during vegetative growth; I2, no irrigation for 32 days during flowering; and I3, no irrigation for 30-40 days during podfilling. Within each irrigation treatment four drought levels were maintained: wet, medium wet, medium dry, and dry. The plants showed extreme drought avoidance in the presence of soil water deficits or high evaporative demands, with xylem pressure potentials remaining above -18 bar. There was no significant difference between cultivars. Several mechanisms for regulating water loss were operating to produce drought avoidance. Predawn xylem pressure potential was more consistently related to soil water deficits than afternoon values. Leaf solute potential was correlated with xylem pressure potential, being more negative in the after-

noon than predawn. Solute potential was also more negative during periods of high evaporative demands but was only slightly reduced by soil water deficits. Large differences in seed yield were produced by small differences in cumulative xylem pressure potential. The difficulties involved in detecting these small differences by the pressure chamber method may preclude the use of this method as an indicator for commerical irrigation of cowpeas. (Cassar-FRC)
W83-01681

MODELS OF ALFALFA YIELD AND EVAPOTRANSPIRATION,
Neveda Univ., Reno. Dept. of Plant, Soil, and Water Science.
J. C. Guitjens.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR3, p 212-222, September, 1982. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Evapotranspiration, *Crop yield, *Irrigation efficiency, Alfalfa, Water use, Nevada, Model studies.

Alfalfa yields in response to evapotranspiration were studied during 1973-1978 in lysimeters located at Fallon, Nevada. Yields and evapotranspiration, expressed annually or per cutting, were directly related. Water use efficiency was independent of evapotranspiration on an annual basis and weakly dependent on a per cutting comparison when all cuttings were plotted together. About 25% of annual evapotranspiration occurred during the dormancy period, September 20 to May 20. Annual yields varied from 5 to over 10 tons per acre. The first cutting produced a maximum of 4 tons per acre; subsequent cuttings produced lower yields in a descending order. Water use efficiency was generally 1-2 tons per 6 acre-inch of water. Water can be conserved by reducing surface runoff and deep drainage, making more water available for evapotranspiration. At 100% irrigation efficiency a 6 ton per acre crop was equivalent to 33 inches of annual evapotranspiration; 10 tons per acre was equivalent to 55 inches of annual evapotranspiration. (Cassar-FRC)
W83-01683

RESPONSE OF FOUR GRAIN LEGUMES TO WATER STRESS IN SOUTH-EASTERN QUEENSLAND. III. DRY MATTER PRODUCTION, YIELD AND WATER USE EFFICIENCY,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia), Div. of Tropical Crops and Pastures.
R. J. Lawn.
Australian Journal of Agricultural Research, Vol 33, No 3, p 511-521, 1982 2 Fig, 5 Tab, 6 Ref.

Descriptors: *Soil water, *Crop yield, *Plant growth, Moisture availability, Water stress, Moisture stress, Water use, Cowpea, Soybean, Green gram, Irrigation, Rainfall, Queensland, *Australia.

The dry matter production, seed yield and water use efficiency of four grain legumes are discussed in terms of the interaction of the respective stress response strategies with the seasonal availability of water in three cultural management systems. Conditions examined included irrigated, rain-fed fallowed and rain-fed double-cropped culture. The major effect of differences between strategies was related to differences in the short term rate of soil water use, which together with the seasonal pattern of water availability influenced both the total and seasonal pattern of water use. Regardless of strategy adopted, dry matter production was primarily a function of water use. Regardless of strategy adopted, dry matter production was primarily a function of water use. However, seed yield and water use efficiency for seed yield depended on the seasonal pattern of water use. The relative agronomic success of the various strategies therefore depended on the seasonal profiles of water availability. Some implications of the differences in stress response strategy for adaption of these species to agricultural environments are discussed. (Baker-FRC)
W83-01692

ZERO-INERTIA MODELING OF FURROW IRRIGATION ADVANCE,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliott, W. R. Walker, and G. V. Skogerboe.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR3, p 179-195, September, 1982. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Furrow irrigation, *Wetting, *Irrigation design, *Model studies, Mathematical models, Surface irrigation, Infiltration, *Zero-inertia models, *Colorado.

The advance phase of furrow irrigation is described by a mathematical model based on equations of mass and momentum conservation. The model is simplified by incorporating the zero-inertia theory, in which the inertial terms in the momentum equation are neglected. Power curve relationships are used to relate the flow depth and wetted perimeter to the cross-sectional flow area. The modified Kostiakov equation is used to describe infiltration. Results of field evaluations at three Colorado locations agreed reasonably well with predicted values. The advance rate was overestimated in some cases and underestimated in others. The early stages of advance was estimated much better than the later stages. (Cassar-FRC)
W83-01696

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

LABORATORY TESTS OF WATER LEVEL RECORDERS AND BROAD-CRESTED V-NOTCH WEIRS FROM THE ST. ANTHONY FALLS HYDRAULIC LABORATORY, MINNEAPOLIS, MINNESOTA,
For primary bibliographic entry see Field 7B.
W83-01462

DESIGN FREEBOARD AND ECONOMIC EFFICIENCY,
Army Corps of Engineers, Baltimore, MD.
For primary bibliographic entry see Field 6B.
W83-01476

MODELLING SIDE-WEIR DIVERSION STRUCTURES FOR STORMWATER MANAGEMENT,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering.
W. James, and H. Mitri.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 197-205, June, 1982. 6 Fig, 8 Tab, 18 Ref.

Descriptors: *Model studies, *Storm wastewater, *Computer models, Combined sewer overflows, SWMM-EXTRAN, OVERFLO3, SIDWEIR, Urban runoff, Hamilton, Canada, Storm water, Water management, *Ontario.

A model has been formulated of the Hamilton, Ontario urban drainage system in order to estimate annual loadings to the harbor receiving water of suspended solids, BOD5, nitrogen, and phosphates. In this city combined sewer diversions are designed to divert significant flows directly to the receiving water during rainstorms. It was necessary to compute continuous hydrographs and pollutographs for the full period of potential overflow in order to estimate pollutant loadings to the recipient water. Since a diversion is active only during part of a storm, diverting only part of the flow, a rating curve for the diversion structure had to be obtained. Few structures have been adequately calibrated, and their rating curves are not usually available. The hydraulics of the side spillways and the SWMM-EXTRAN computer program were reviewed. A new program called OVERFLO3 was developed to dovetail with the SWMM package. Internal SWMM coding has not been changed. As a stand-alone program, OVERFLO3 will produce rating curves for side-weir diversion structures. The program was applied to the urban catchments in Hamilton. The general conclusions were that simulation of side-weir diversion flows in the SWMM-EXTRAN program appeared unacceptable for certain conditions, that the program OVERFLO3 appeared to provide a more satisfactory method for computing side-weir water surface profiles and overflows than is presently provided by SWMM-EXTRAN, and that the new block SIDWEIR can be used to produce overflow hydrographs for diversion structures with side-weirs, using a slightly modified form of the SWMM package. (Baker-FRC)
W83-01555

AN APPROACH TO SOLVING A BASIN-WIDE WATER RESOURCES MANAGEMENT PLANNING PROBLEM WITH MULTIPLE OBJECTIVES,
California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 6A.
W83-01574

ALTERED HYDROLOGY OF THE MISSOURI RIVER AND ITS EFFECTS ON FLOODPLAIN FOREST ECOSYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W83-01603

A STOCHASTIC DYNAMIC PROGRAMING MODEL FOR THE OPERATION OF THE MEDITERRANEAN-DEAD SEA PROJECT,
Israel Electric Corp. Ltd., Haifa. Research and Development Div.
D. Weiner, and A. Ben-Zvi.
Water Resources Research, Vol 18, No 4, p 729-734, August, 1982. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Hydroelectric plants, *Stochastic hydrology, *Reservoir operation, Mediterranean Sea, Dead Sea, *Israel, Water control, Water conveyance, Benefits, Dynamic programming, Water level, Flood data, Withdrawal, Lakes, Saline lakes, Hydrologic models, Model studies, *Mediterranean-Dead Sea Project.

The Mediterranean-Dead Sea Project is designed to generate hydroelectric power from water flowing 72 miles from the Mediterranean to the Dead Sea, 400 meters below sea level. This is feasible because increasing withdrawals from the Dead Sea have lowered the level significantly. The project would include a booster pumping station, canal, tunnel two reservoirs at different levels, and a power plant. This paper provides a model for optimizing the Mediterranean water inflows, considering the highly variable natural inflows into the Dead Sea. The model uses a stochastic dynamic programming algorithm to maximize the discounted expected value of the hydroelectric plant benefits. The algorithm also determines the operational level of the Dead Sea with respect to the probability of occurrence of heavy floods. Results show that the maximum rate of water inflow (1.6 billion cu m per year) is recommended at levels less than -396 m. At higher levels the rate of water inflow should be reduced or stopped. The level at which potash plants would be heavily damaged is -391 m. Largest expected river flows to the Dead Sea are 2.55 billion cu m per year. The average inflow before 1930 was 1.6 billion cu m per year. (Cassar-FRC)
W83-01728

RELIABILITY PROGRAMING IN RESERVOIR MANAGEMENT. 3. SYSTEM OF MULTIPURPOSE RESERVOIRS,
Institut za Vodioprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
S. P. Simonovic, and M. A. Marino.
Water Resources Research, Vol 18, No 4, p 735-743, August, 1982. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Reservoirs, *Programming, *Reliability, Water resources development, Water supply, Risks, Stochastic hydrology, Stochastic process, Mathematical studies, Red River, Oklahoma, Texas.

This paper extends the reservoir reliability program of Simonovic and Marino, 1980, to the analysis of optimal operating strategies for multipurpose reservoir systems. The procedure can be applied to any multipurpose multiunit reservoir system with two general types of linkage: normal channel flow for reservoir releases and pipelines or pumping canals. Thus each reservoir could be connected to every other reservoir and each could receive releases from any or all other reservoirs as dictated by a particular system configuration. A two-level solution algorithm is proposed. A solution can be obtained for a reservoir system with few purposes (flood control, power production, irrigation, water supply and water quality enhancement) and random inflows and demand. The inflows and demands are represented by conditional distribution functions. The objective function of economic efficiency, representing the tradeoff between benefits and risks embodied by a risk-loss function, is included. The reliability programming model is nonlinear and can be split into two models: search model and special linear programming model. Results of the operation of the system, including optimal operating policies for the reservoirs and reliabilities of the operation, illustrate the major advantages of the reliability programming approach compared with other stochastic optimization techniques. (Baker-FRC)
W83-01735

AN APPROACH TO OPTIMIZING RESERVOIR OPERATION FOR DOWNSTREAM AQUATIC RESOURCES,
Oak Ridge National Lab., TN.
M. J. Sale, E. D. Brill, Jr., and E. E. Herricks.
Water Resources Research, Vol 18, No 4, p 705-712, August, 1982. 6 Fig, 29 Ref.

Descriptors: *Multiobjective planning, *Reservoir operation, *Instream flow, Optimization, Multipurpose reservoirs, Lake Shelbyville, *Illinois, Planning, Environmental quality, Fish habitats, Water resources development, Model studies, Mathematical models, Flood control, Recreation, Economic efficiency, Water yield, Reservoir releases, Flow agumentation.

A mathematical programming methodology is proposed to examine the relationship between biological instream flow needs and traditional water project objectives such as water yield, flood control, reservoir recreation, and economic efficiency. This optimization approach combines the linear decision rule modeling technique with an objective function representing the value of reservoir releases to downstream fisheries. The instream flow needs performance objective is based on an index of physical habitat conditions, the weighted usable area. The procedures are used to evaluate operating policies at Lake Shelbyville, a multipurpose reservoir on the Kaskaskia River, Illinois. Since the reservoir began operation in 1970, operating problems resulting in periods of flood and excessively low streamflow have not allowed consistent meeting of objectives. A revised management procedure recommends more gradual changes in pool elevations, more empty storage space during winter, and falling pool elevations in July-October to augment low flows. (Cassar-FRC)
W83-01739

4B. Groundwater Management

SIMULATED EFFECTS OF GROUND-WATER DEVELOPMENT ON THE POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W83-01401

CHARACTERIZATION OF AQUIFERS DESIGNATED AS POTENTIAL DRINKING WATER SOURCES IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
L. A. Gandl.
Geological Survey Open-File Report 81-550 (WRI), 1982. 90 p, 56 Fig, 3 Plates, 2 Tab, 44 Ref, Append.

Descriptors: *Groundwater, *Aquifers, *Drinking water, *Potential water supply, *Water management, Dissolved solids, Water quality control, Underground waste disposal, Potentiometric level, Wells, Water use, Saline-freshwater interfaces, Available water, *Mississippi.

The Environmental Protection Agency has established that all ground water having a dissolved-solids concentration of less than 10,000 milligrams per liter is to be protected from injection of waste material. The Underground Injection Control program is intended to protect aquifers that are possible future sources of drinking water. Fourteen aquifers in Mississippi have been studied and their downdip limits for water containing 10,000 milligrams per liter dissolved solids have been delineated. Maps have been prepared showing the top, bottom, thickness, and potentiometric surface of the aquifers. (USGS)
W83-01403

CHARACTERISTICS AND EFFECTS OF GEOTHERMAL RESOURCES EXPLOITATION,
Bureau de Recherches Geologiques et Minieres, Paris (France).
A. Menjoz, and J. P. Sauty.
Journal of Hydrology, Vol 56, No 1/2, p 49-59, March, 1982. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Geothermal resources, *Injection wells, Wells, Exploitation, Geochemistry, Pumping, Groundwater movement, Cooling, *France, Dogger of the Paris Basin.

Doublet or multiwell geothermal exploitation systems are preferable to single well pumping under most circumstances because they avoid progressive depressurization of the well field and allow easy disposal of saline spent geothermal fluids. A single well with a flow rate of 120 cu m per hour can lower pressure and well levels at great distances: 1 bar at 10 km in the first year, 5 bars at 10 km after 30 years, and 10 bars at 1 km after 30 years. The same well produces the following drawdowns after 1 and 30 years, respectively: 217 m and 279 m at the well, 36 m and 98 m at 1 km and 0 and 50 m at 10 km. The doublet system limits depressurization to the immediate vicinity and allows similar systems to be installed at distances specified by the cooling effects of the injected cold spent water. Reinjection alters the chemical and physical properties of the geothermal reservoir by degassing, corrosion of piping materials, dissolution, precipitation, and clogging. (Cassar-FRC)
W83-01496

OPTIMUM CROPPING AND GROUND WATER MANAGEMENT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soil and Water Engineering.
S. D. Khepar, and M. C. Chaturvedi.
Water Resources Bulletin, Vol 18, No 4, p 655-660, August, 1982. 5 Tab, 20 Ref.

Descriptors: *Groundwater management, *Crop yield, *Irrigation, Farming, Water management, Water supply, Salinity, Model studies.

Decision models were developed for optimum groundwater management alternatives in conjunction with optimum cropping patterns, using fixed yield and alternative levels of water use approaches, based on water production functions, in canal irrigated areas under arid environments. The alternative levels of irrigation water assumed are 25%, 50%, 75% and 100% of water required for maximum production, using both of the groundwater management alternatives as explained. The results indicate that by adopting conjunctive surface and groundwater development and optimum cropping pattern, even when giving full water requirements, the returns increased by 21-25%. Also, if optimum, rather than maximum water is used, the returns are increased by 44 to 49% from the initial values. This suggests that top priority should be given to farm advisory services for disseminating technical information on the proper use of irrigation water and optimum cropping patterns to sustain agricultural production and maximize the returns. Large size tubewells are distinctly more economical than small tubewells, providing an economy of about 4%. However, they involve collective, governmental, or cooperative management. (Baker-FRC)
W83-01505

GROUND WATER USE IN AN ENERGY DEVELOPMENT AREA: THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
D. H. Hickcox.
Water Resources Bulletin, Vol 18, No 4, p 585-591, August, 1982. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Groundwater, *Water demand, *Water conservation, *Montana, Ranching, Semiarid regions, Tongue River, River basins, Aquifers, Legal aspects, Coal mining, Water pollution sources, Water quality.

Extensive use of groundwater in the Tongue River Basin has enabled much of the basin to be used for grazing in this area of southeastern Montana. The widespread availability of water in a semiarid region encouraged ranching to develop. Coal mining represents a threat to the ranching and water quality of the area. Strip mining in particular is proceeding at an accelerated pace without adequate knowledge of groundwater hydrology. Local water supplies have been severely affected in some areas. Construction of mine-mouth power plants and synthetic fuel plants will require more water than is available from streams, reservoirs, and shallow aquifers. Urban development will also need large quantities of high quality water. Prior to 1961 there was no legal system in Montana for regulating groundwater appropriation. In 1973 the groundwater statutes were revised to make them clearer, more precise and easily workable. Provisions were made to establish areas of controlled groundwater use. Montana Department of Natural Resources and Conservation can refuse access if withdrawal exceeds the capacity of the aquifer, if water is wasted, or if water is used for nonbeneficial purposes. (Baker-FRC)
W83-01508

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA, PHASE 2--EFFECTS OF PUMPING ON WATER LEVELS AND WATER QUALITY IN THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, Sacramento, CA. Water Resources Div.
P. Martin.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $7.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-366, April 1982. 53 p, 12 Fig, 7 Tab, 20 Ref.

Descriptors: *Groundwater, *Monitoring, *Saline water intrusion, *Water quality, *Observation wells, Aquifers, Water level, Pumping, Drawdown, Artificial recharge, Groundwater movement, Reservoir releases, Water quality, Degradation, Path of pollutants.

From July 1978 to January 1980, water levels declined more than 100 feet in the coastal area of the Santa Barbara ground-water basin in southern California. The water-level declines are the result of increases in municipal pumping since July 1978. The pumping, centered in the city less than 1 mile from the coast, has caused water-level declines in the main water-bearing zones to altitudes below sea level. Consequently, the ground-water basin is threatened with salt-water intrusion if the present pumpage is maintained or increased. Water-quality data suggest that salt-water intrusion has already

degraded the water yielded from six coastal wells. Chloride concentrations in the six wells ranged from about 400 to 4,000 milligrams per liter. Municipal supply wells near the coast currently yield water of suitable quality for domestic use. There is, however, no known physical barrier to the continued inland advance salt water. Management alternatives to control salt-water intrusion in the Santa Barbara area include (1) decreasing municipal pumping, (2) increasing the quantity of water available for recharge by releasing surplus water to Mission Creek, (3) artificially recharing the basin using injection wells, and (4) locating municipal supply wells farther from the coast and farther apart to minimize drawdown. (USGS)
W83-01513

SHROPSHIRE GROUNDWATER SCHEME BEGINS,
Severn-Trent Water Authority (England).
M. A. Sayers.
Water Services, Vol 86, No 1035, p 225-226, May, 1982. 1 Fig.

Descriptors: *Groundwater potential, *Boreholes, *Water resources development, *Rivers, Water supply development, Environmental effects, Shropshire, *United Kingdom, River Severn.

The first stage of the Shropshire groundwater development scheme is described, which includes the drilling of six observation boreholes to investigate water sources for the River Severn. The Shropshire scheme was designed to quantify natural recharge to and discharge from the aquifer and to determine the potential yield and optimum method to achieve yield and the environmental impact of any development program on the existing water sources. The boreholes currently being drilled will be 80 m to 140 m in depth and will be used for river regulation by 1985. If regulation is not required, pumping tests will be performed to determine the operational net yield and aquifer response and to compare observed water levels with those predicted by models. (Small-FRC)
W83-01530

PATHOGEN REMOVAL FROM WASTEWATER DURING GROUNDWATER RECHARGE,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5D.
W83-01701

FATE OF INORGANIC MICRO-CONTAMINANTS DURING GROUNDWATER RECHARGE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W83-01702

GROUNDWATER RECHARGE - CASE STUDIES; CEDAR CREEK WASTEWATER RECLAMATION AND GROUNDWATER RECHARGE FACILITY, NASSAU COUNTY, NEW YORK,
Nassau County Dept. of Public Works, NY.
F. J. Flood, Jr., and R. J. Avendt.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 255-264, 1 Fig, 3 Tab.

Descriptors: *Wastewater renovation, *Wastewater treatment, *Groundwater recharge, *Reclaimed water, *Water supply development, Biological treatment, Chemical treatment, Recharge basins, Injection wells, Monitoring, Filtration, Adsorption, Carbon, Chlorination, Primary wastewater treatment.

In the early 1950's, Nassau County began a wastewater collection and treatment program; however, the program resulted in a decrease in freshwater streamflow, higher bay salinity, and landward movement of salty groundwater. Aquifer replenishment was needed. Two feasibility studies were made and subsequent recommendations and plans were for a 5.5 mgd water reclamation-recharge facility using portions of the existing Cedar Creek Plant. The project has three major components: water reclamation facility, transmission main; and recharge facility. The water reclamation processes include chemically aided primary sedimentation, two or three stage biological treatment, filtration, carbon adsorption, chlorination, and storage. The transmission main system requires a 24-inch diameter concrete pipe to convey the reclaimed water to the recharge site about 6.25 miles away. At the recharge site, 4 mgd are recharged, with approximately 2.0 mgd recharge through basins and the other 2.0 through wells. Five wells and 11 basins are used, with 4 wells in operation at any given time. Each well recharges 0.5 mgd. In addition to an observation well network, a reservoir sampling pump coupled with a composite sampler is provided to analyze reservoir water for dissolved oxygen, turbidity, temperature, pH, chlorine residual and specific conductance. Removal efficiencies for trace organics and viruses will also be monitored continuously. Long term assessment of the reliability, economics and environmental response of a large-scale reclamation-recharge facility is involved in this 3 to 5 year, $8.1 to $14.3 million demonstration project. (Atkins-Omniplan)
W83-01703

SELECTING TREATMENT PROCESSES TO MEET WATER REUSE REQUIREMENTS,
Culp/Wesner/Culp, El Dorado Hills, CA.
R. L. Culp.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 41-54, 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Ground recharge, *Artificial recharge, *Reclaimed water, *Water reuse, *Injection, Land spreading, Wastewater disposal, Pretreatment of water, Water quality, Aeration, Filtration, Percolation, Aquifers, Estimated costs.

Aquifer recharge can be either direct, via injection wells, or indirect, using surface spreading of treated wastewater. Either way, the recharge water is diluted when mixed with the groundwater and some purification occurs when the water passes through the granular water-bearing materials. Two other factors, time-in storage and separating recharge and withdrawal points, provide a loss of identity for wastewater recharge and add to the safety of reuse. A disadvantage of wastewater recharge is that the mixture must meet or exceed drinking water standards. All water reuse projects are developed of necessity but must consider local conditions, quality requirements for various uses, degree of contaminant removal, health risks, environmental issues, and costs. Agriculture, steam electric power generation and manufacturing account for 90% of total water uses and wastewater receiving secondary treatment will satisfy quality requirements for most recharge projects. But the costs might not be justified for the other 10%. In California, water used in recharge projects must meet minimum pretreatment standards. In the case of surface spreading, the requirements for disinfection, chemical treatment, filtration, reverse osmosis and stripping can be eliminated, whereas injection requires them. A summary of five sets of groundwater and pretreatment costs is provided. The lowest cost system is for secondary treatment in aerated lagoons followed by surface spreading; the highest is for well injection into a potable water source and includes activated sludge, highlime treatment, recarbonation, flow equilization, filtration, GAC adsorption, reverse osmosis and ozonation. Estimates are given for 1, 10 and 50 mgd systems. (Atkins-Omniplan)
W83-01705

GROUNDWATER RECHARGE OPERATIONS IN CALIFORNIA,
California State Water Resources Control Board, Sacramento.
T. Asano, and K. L. Wassermann.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 12-26, 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Reclaimed water, *Water reuse, *Water supply development, Industrial wastewater, Municipal wastewater, Storage reservoirs, Aquifers, Groundwater basins, Groundwater storage, Groundwater depletion, Infiltration, Pathogens, Heavy metals, Groundwater potential, *California.

Wastewater reclamation and reuse have become important factors in meeting California's water demand. Statewide water demand in the year 2000 could exceed supplies by as much as 6.6 million ac/ft/yr unless new supplies are developed and/or management techniques are improved. There are five major groundwater recharge operations using reclaimed water in California. In 1977, they reclaimed about 26,000 ac/ft, or 14.2%, of the total reclaimed water; increased recharge is expected at all five in the future, and a ten-fold increase in volume statewide for groundwater is projected. Recharge by surface spreading is most advantageous in metropolitan and agricultural areas where groundwater overdraft is severe, and has the added benefits of the filtering effect of soils and transporting facilities of aquifers. Recharge by injection is usually used when the groundwater is deep or in urban areas where basin recharge is impractical. It is most effective in creating freshwater barriers in coastal aquifers to prevent sea water intrusion, however, extensive above-ground wastewater treatment is necessary. Recent studies show that 50,000 ac/ft/yr of reclaimed water for salt water intrusion barriers, and 80,000 ac/ft/yr for spreading have been identified in Los Angeles and Orange Counties. However, concern for long-term health effects has prevented expansion and discouraged new projects. Four water quality factors are of particular significance: microbiological, total minerals, mineral toxicants of the heavy metal type, and stable organic substances. A consulting panel was created to study these and other problems and to recommend a program of research and development. (Atkins-Omniplan)
W83-01706

DEVELOPMENT OF TECHNICAL SITE SELECTION CRITERIA FOR ARTIFICIAL RECHARGE,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
W. W. Wood.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 73-79, 4 Ref.

Descriptors: *Artificial recharge, *Site selection, *Prediction, *Water properties, *Design criteria, Water management, Aquifers, Chemical analysis, Water treatment, Anaerobic conditions, Recharge basins, Water quality, Research priorities.

Artificial recharge has often been neglected as a water management technique for lack of suitable site selection criteria. Six general factors must be quantified to develop these criteria: rate of recharge, water quality, aquifer storage capacity, rate of recovery from aquifer, quality of extracted water, and aquifer plugging. More work is needed in the first five areas; however, some predictions can be made in each of them and they are also being evaluated in other areas in the field of hydrology. Of particular importance is predicting the onset of aquifer plugging by chemical, physical and biological mechanisms, which results in reduction in hydraulic conductivity. Plugging of artificially recharged aquifers by biological growth is a serious problem that occurs due to in-situ growth of bacteria at or near the water-aquifer interface. Chemically induced plugging involving clay dispersion and flocculation also results in significant reduction of the aquifer's hydraulic conductivity. Plugging by mineral precipitation has not been a serious problem. Because of the lack of predictive

capabilities in the areas of plugging, two empirical approaches have been developed. The first is to remove all particulate material and organic substances and chemically adjust the water to match that in the aquifer. The second is to let the aquifer provide the water quality improvement. A combination of the two is often used. Future research should be directed toward these fundamental problems, rather than continuing with the site-specific experiments that have prevailed in the past. (Atkins-Omniplan)
W83-01707

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-01708

A STUDY ON THE HEALTH ASPECTS OF GROUNDWATER RECHARGE IN SOUTHERN CALIFORNIA,
County Sanitation Districts of Los Angeles County, Whittier, CA.
For primary bibliographic entry see Field 5C.
W83-01709

4C. Effects On Water Of Man's Non-Water Activities

HYDROLOGY OF THE COAL-RESOURCE AREAS IN THE UPPER DRAINAGES OF HUNTINGTON AND COTTONWOOD CREEKS, CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5C.
W83-01408

HYDROLOGIC CHARACTERISTICS AND POSSIBLE EFFECTS OF SURFACE MINING IN THE NORTHWESTERN PART OF WEST BRANCH ANTELOPE CREEK BASIN, MERCER COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
M. E. Crawley, and D. G. Emerson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-218371, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-79, December 1981. 73 p, 25 Fig, 11 Tab, 46 Ref.

Descriptors: *Coal mining, *Water pollution effects, *Water quality, *Surface water, *Groundwater, Aquifers, Groundwater movement, Observation wells, Well data, Water level fluctuations, Precipitation, Mine drainage, Rainfall-runoff relationships, Environmental effects, Chemical analysis, Data collections, *North Dakota, Mercer County, Fort Union coal region.

Lignite beds and abundant discontinuous sandstone beds of the Paleocene Sentinel Butte Member of the Fort Union Formation and sand and gravel beds in the Quarternary glaciofluvial deposits (Antelope Creek aquifer) are the most important aquifers for domestic and livestock water supplies in the West Branch Antelope Creek basin. In the Beulah-Zap lignite, ground water moves from highland area in the west toward the Antelope Creek aquifer. Water levels in the basal Sentinel Butte sandstone appear to be controlled by the level of Lake Sakakawea. In the glaciofluvial deposits of the Antelope Creek aquifer water moves from a ground-water divide northwestward to Lake Sakakawea and southeastward toward the Knife River. Large water-level declines in wells completed in the lignite and shallower aquifers could be expected with mining. The effects probably would be limited to within 1 to 2 miles of an active mine. Surface-runoff duration could be altered by increased infiltration and retention in the reclaimed are and possible temporal extension of base flow could occur. Shallow ground water beneath mine sites would be expected to increase in dissolved solids and locally to contain large sodium and sulfate concentrations. In some locations movement of poor quality water toward the Antelope Creek aquifer would be expected. (USGS)
W83-01409

PHYSICAL, HYDROLOGICAL, AND BIOLOGICAL CHARACTERISTICS OF THE LOXAHATHCEE RIVER ESTUARY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. F. McPherson, M. Sabanskas, and W. A. Long.
Geological Survey Open-File Report 82-350 (WRI), 1982. 1 Sheet, 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Maps, *Estuaries, *Flow characteristics, *Bathymetry, Tides, Sand, Bottom sediments, Aquatic plants, *Florida, Loxahatchee River, Sea grass.

The Loxahatchee River estuary in southeast Florida has periodically closed and opened to the sea as a result of natural causes. In the last 30 years, the estuary has remained open only by dredging. Activities of man in the estuary and basin affect freshwater and tidal flow which in turn affect bathymetry, bottom sediment, and biota. Under present conditions, tidal flow is much larger than freshwater inflow. (USGS)
W83-01518

POTENTIAL HYDROLOGIC EFFECTS OF DEVELOPING COAL AND OTHER GEOENERGY RESOURCES IN OREGON--A REVIEW,
Geological Survey, Portland, OR. Water Resources Div.
W. C. Sidle.
Geological Survey Open-File Report 81-1014 (WRI), 1981. 29 p, 3 Fig, 1 Tab, 53 Ref.

Descriptors: *Hydrology, *Geothermal resources, *Coal mines, *Exploration, Oil shale, Natural gas, Hot springs, Wells, Water quality, Surface water, Groundwater, *Oregon.

Southwestern Oregon has several hundred million tons of good-quality minable coal. Because of the dip of the coal beds, the only economical method of mining would be by underground methods. In addition, minor occurrences of low-quality coal have been noted at more than 20 sites in both western and northeastern Oregon. About 2 million acres are now under lease for petroleum and gas exploration across the State. Natural gas was discovered in northwestern Oregon in 1979, and current production is about 17 million cubic feet per day from five wells. Thirteen Known Geothermal Resource Areas in several parts of the State cover 432,000 acres, and more than 420,000 acres are under lease for geothermal exploration. No hydrologic impacts have been noted from exploration and production of coal or other geoenergy resources in Oregon. (USGS)
W83-01520

SOME HYDROTECHNICAL PROBLEMS RELATED TO THE CONSTRUCTION OF A CAUSEWAY IN THE ESTUARY OF THE PETITCODIAC RIVER, NEW BRUNSWICK,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
D. I. Bray, D. P. DeMerchant, and D. L. Sullivan.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 296-307, June, 1982. 12 Fig, 1 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Road construction, *Environmental effects, Causeway, Sedimentation, Bed load, Estuaries, Petitcodiac River, *New Brunswick, Canada, Geomorphology, Sediment transport, Flood control.

Significant geomorphological changes in the Petitcodiac River estuary resulting from closure of the estuary in 1968 by a causeway are summarized. Changes were noted in the seasonal variation of bed level immediately downstream of the control structure. The net upstream transport of sediment was altered at the control structure due to the adopted operating procedures, and the types of beaches that are being formed at the periphery of the reservoir upstream of the causeway are also different. In addition, the initial effects of removing all gates at the control structure, based on the results of a simplified computer model, are presented. Typical results for the case of the mean river flow of 25 cubic meters/sec and a high tide elevation of 5.8 m are presented. These results indicate that the maximum reservoir level will be about 0.6 m lower than the high tide level and that the reservoir will almost completely drain to the level of the downstream bed rock control during the ebb tide. These computed results apply only for the situation immediately following the removal of the gates. With the gates removed there will be a net transport of sediment upstream through the control structure. Rough estimates indicate that an upstream tidal prism would develop with a volume of about 60% of the precauseway volume. The channel downstream of the causeway would appreciably increase in width to a value of about twice the channel width before removing the gates. (Baker-FRC)
W83-01539

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 6. SILVICULTURAL TREATMENTS,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
For primary bibliographic entry see Field 5C.
W83-01571

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 3. TIMBER HARVEST,
British Columbia Ministry of Environment, Victoria.
T. W. Chamberlin.
U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, General Technical Report PNW-136, Portland, Oregon, April 1982. 33 p, 11 Fig, 3 Tab, 66 Ref.

Descriptors: *Aquatic habitats, *Anadromous fish, *Logging, *Runoff, *Streamflow, *Water quality, Forest management, Environment effects, Evapotranspiration, Precipitation, Snowmelt, Interception, Vegetation, Debris, Erosion.

Felling and yarding of trees cause changes to anadromous fish habitat in western North America through changes in water and land-system processes. Harvesting may substantially change the distribution of water and snow on the ground, the amount intercepted or evaporated by foliage, the rate of snowmelt or evaporation from snow, the amount that can be stored in the soil or transpired from the soil by vegetation, and the physical structure of the soil, which governs the rate and pathways of water movement to stream channels. All of these factors may affect streamflow. Forest harvesting activities directly influence fish habitat in four habitat in four major areas: acceleration of erosion and mass-movement processes; introduction and removal of organic debris; alteration of channel shape; and removal of streamside vegetation. With adequate knowledge of the characteristics of particular streams, enhancement of some habitats is possible. Evidence suggests that increased runoff from evapotranspiration and interception losses alone does not increase high flows sufficiently to be of concern. Much greater flow increases may be caused by synchronization of snowmelt or in conjunction with rain-on-snow events. The principal water quality parameters that may be influenced by felling and yarding are temperature, suspended sediment, dissolved oxygen, and nutrients. Other habitat factors which may be influenced by timber harvesting include: streambed material compostion and scour; steambank structures; cover; riparian vegetation; and migration barriers. (Moore-SRC)
W83-01572

ANALYSIS OF THE EFFECT OF CHANGING DISCHARGE ON CHANNEL MORPHOLOGY AND INSTREAM USES IN A BRAIDED RIVER, OHAU RIVER, NEW ZEALAND,

Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Science Centre.
M. P. Mosley.
Water Resources Research, Vol 18, No 4, p 800-812, August, 1982. 10 Fig, 23 Ref.

Descriptors: *Channel morphology, *Fish habitats, *Braided streams, Ohau River, *New Zealand, *Ecological effects, Stream discharge, Reservoir releases, Recreation, Environmental effects, Low flow, *Instream uses.

The effects of constant water discharges of 26.5, 56.7, 105, 240 and 507 cu m per sec on the morphology of a braided river were studied in the Ohau River, New Zealand, downstream from a complex of power stations. Water depths and mean velocities were measured along 2 to 8 cross sections in a 1.4 km long reach. Stereo vertical aerial photographs were also taken during each discharge. Frequency distributions of water depth and velocity were determined singly and jointly for each discharge. As discharges increased, existing channels became wider, deeper, and faster, frequently merging into a single larger channel. However, additional channels with the same characteristics as those formed at lower discharges were created. The total number of channels at a cross section remained constant. Therefore, the increase of water surface area was by addition of faster, deeper water to a constant area of shallow, slow water, which changed location in the river bed. The area suitable for salmonid spawning appeared to remain constant over a wide range of flows (20-200 cu m per sec), indicating that the braided river is more stable morphologically than a single channel river. At present this river maintains discharges within the 20-200 cu m per sec range 60% of the time. After completion of a third power station on the river, flow is expected to be 5 cu m per sec. Although effects of this low flow on the fish population cannot be predicted without further studies, severe deterioration of the habitat may not occur because of the conservative nature of the braided river. (Cassar-FRC)
W83-01732

4D. Watershed Protection

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1979-80,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-01402

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTHWEST LAND MANAGEMENT AND CONSERVATION RESEARCH CENTER,
Agricultural Research Service, Pullman, WA. Land Management and Water Conservation Research Unit.
For primary bibliographic entry see Field 7A.
W83-01449

SLEEPERS RIVER RESEARCH WATERSHED, DANVILLE, VERMONT,
For primary bibliographic entry see Field 7A.
W83-01450

GRASSLAND, SOIL AND WATER RESEARCH LABORATORY, TEMPLE, TEXAS,
Agricultural Research Service, Temple, TX.
For primary bibliographic entry see Field 7B.
W83-01451

QUALITY OF WATERSHED DATA FROM THE NORTHEAST WATERSHED RESEARCH CENTER,
For primary bibliographic entry see Field 7B.
W83-01452

REPORT ON QUALITY OF PRECIPITATION, RUNOFF AND EROSION PLOT DATA FROM THE COLUMBIA PLATEAU CONSERVATION RESEARCH CENTER,
For primary bibliographic entry see Field 7A.
W83-01453

DISCHARGE RATINGS OF A SANTA RITA FLUME, WATER CONSERVATION STRUCTURES LABORATORY, STILLWATER, OKLAHOMA,
For primary bibliographic entry see Field 7B.
W83-01454

REPORT ON QUALITY OF WATERSHED DATA FROM THE WATER CONSERVATION STRUCTURES LABORATORY, STILLWATER, OKLAHOMA,
For primary bibliographic entry see Field 7A.
W83-01455

ACQUISITION AND QUALITY OF WATERSHED DATA FROM THE SOUTHERN PLAINS WATERSHED AND WATER QUALITY LABORATORY,
Agricultural Research Service, Durant, OK. Watershed and Water Quality Lab.
For primary bibliographic entry see Field 7A.
W83-01456

QUALITY OF WATERSHED DATA AT THE NORTH APPALACHIAN EXPERIMENTAL WATERSHED, CONSHOCTON, OHIO,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 7A.
W83-01457

REPORT ON QUALITY OF DATA FROM THE DEE CREEK WATERSHED, LINCOLN, NEBRASKA,
For primary bibliographic entry see Field 7B.
W83-01458

REPORT ON QUALITY OF WATERSHED DATA, USDA SEDIMENTATION LABORATORY,
For primary bibliographic entry see Field 7A.
W83-01459

NORTH CENTRAL WATERSHED RESEARCH UNIT, COLUMBIA, MISSOURI,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
For primary bibliographic entry see Field 7B.
W83-01460

QUALITY OF WATERSHED RELATED DATA COLLECTED AT THE SNAKE RIVER CONSERVATION RESEARCH CENTER,
For primary bibliographic entry see Field 7A.
W83-01463

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE SOUTHEAST WATERSHED RESEARCH LABORATORY.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Laboratory.
For primary bibliographic entry see Field 7A.
W83-01467

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER,
Agricultural Research Service, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 7A.
W83-01470

THE POTENTIAL USE OF A DEGRADABLE EROSION CONTROL MEMBRANE IN THE UNITED KINGDOM,
British Sisalkraft Ltd., Strood (England).
M. S. Henderson.
Quarterly Journal of Engineering Geology, Vol 15, No 3, p 233-234, 1982. 2 Fig.

Descriptors: *Erosion control, *Membranes, Erosion, Conservation, Rainfall, Runoff, Soil, Absorption.

There are three steps involved in water erosion: detachment, movement and deposition, of which detachment is the most critical, as this is the beginning of the entire process. Problems associated with erosion are both environmental and economic. A membrane consisting of a knitted yarn netting interwoven with strips of biodegradable paper intended to protect exposed or disturbed soils until the sites are permanently stabilized with vegetative cover has been developed. By providing a physical barrier between the soil surface and rain, the membrane prevents detachment and splashing of soil particles and seeds. The soil aggregates remain intact and are much less susceptible to erosion. The soil structure is maintained, the pores are less likely to be clogged with fine particles and the soil can therefore retain its capacity to absorb water. The material is run out following seeding to lie hugging the contours of the ground and is held firmly in place. Anchor trenches and check slots can easily be incorporated if needed. The membrane shields soil and seed from raindrop impact, minimizes runoff water and slows its velocity, and maintains the soil's capacity to absorb water, holding soil particles and seeds in place and retaining moisture. (Baker-FRC)
W83-01485

FARMERS' ATTITUDES TOWARD GOVERNMENT INVOLVEMENT IN PREVENTING AGRICULTURAL NONPOINT SOURCE WATER POLLUTION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W83-01506

MODEL FOR SIMULATING RUNOFF AND EROSION IN UNGAGED WATERSHEDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
B. B. Ross, M. L. Wolfe, V. O. Shanholtz, M. D. Smolen, and D. N. Contractor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150128, Price codes: A05 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin 130, February 1982. 72 p, 21 Fig, 9 Tab, 73 Ref.

Descriptors: *Watershed model, Land use, *Finite element model, Hydrologic model, Water quality model, *Sediment, Overland flow, Spatial variability, *Stormwater runoff, *Model studies, Simulation, Erosion, Water pollution control.

This research, which developed a distributed parameter model for simulating runoff in ungaged areas, can assist in nonpoint pollution control planning efforts. The sediment detachment and transport component of this finite element storm hydrograph model (FESHM) enables its additional use for simulating erosion processes which result from runoff. Though not dependent on calibration, the FESHM, when applied to field-scale areas, does require extensive information on the fields's soils, topography, and cover characteristics. Application of the FESHM, however, is not limited to field scale areas. Although most research using the model has been conducted on watersheds of 2 to 1,000 acreas, it has performed adequately on watersheds as large as 193 square miles. The FESHM's hydrologic section compares favorably with other watershed models currently in use (ANSWERS, HEC-1, TR-20, and USGS State Equations), in terms preparation and execution costs. A sediment washload capability has been demonstrated but remains unverified. Work is progressing toward verification.
W83-01604

QUANTITATIVE EVALUATION OF FACTORS AFFECTING FLASH FLOODS ON EPHEMERAL WATERSHEDS,

Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2E.
W83-01606

ENVIRONMENTAL CHANGE AND ITS IMPACT ON THE FRESHWATER FISHES OF IRAN,
Pahlavi Univ., Shiraz (Iran). Dept. of Biology.
B. W. Coad.
Biological Conservation, Vol 19, No 1, p 51-80, November, 1980. 1 Fig, 81 Ref.

Descriptors: *Water pollution effects, *Fish management, *Fish stocking, *Fish conservation, *Iran, Fish populations, Wtershed management, Soil erosion, Water quality control, Water pollution control, Reviews, Water level fluctuations, Irrigation effects.

The factors affecting the abundance and distribution of freshwater fish in Iran are reviewed. Among the factors mentioned are climate, devegetation, irrigation, and natural water level fluctuations and factors related to industrialization and population growth. To prevent erosion from devegetation, watershed management is being planned over the catchment area of dams to prevent excessive siltation. In 1967, Iran passed a law to regulate the discharge of pollutants into natural waters. The effects of pollutants on fish are being researched, along with ways to improve water quality. Studies on biodegradable detergents are being conducted to protect groundwater and surface water quality. Sewage systems are not required for all towns on the Caspian littoral. Fish culturing and stocking is being practiced on a small scale. Some of the threatened species are listed. (Geiger-FRC)
W83-01660

A SOIL CONSERVATOR AT WORK,
J. W. Ramsay.
Soil and Water, Vol 16, No 4, p 9-11, August, 1980.

Descriptors: *Soil conservation, *Erosion control, *Planning, Erosion, Conservation, Farming, Agriculture, Forestry, Watershed protection, Land use capbability, Drainage, Water conservation, *New Zealand.

Erosion control and land planning techniques were just beginning to take form in New Zealand 25 years ago. To combat soil erosion the soil conservator now follows five basic steps: identifies the problem, assesses its severity, prepares the proposal, carries out the remedial works, and evaluates the effects of his actions. Land use capability, the ability of the land to withstand sustained use without erosion, is interpreted in an eight class system. Four categories are for intensity of arable use and three for intensity pastoral use. Class VIII is reserved for lands which have little or no agricultural or forestry use but are best suited for watershed protection. The most successful method of implementing erosion control has been by using the soil and water conservation plan where the landowner and soil conservator share knowledge and costs to solve problems. Two methods of erosion control are available: vegetative control and simple engineering works. While erosion control has been most successful to date working through individual farm property soil and water conservation plans, the natural follow-up is to have each plan incorporated into one covering the whole catchment. Planning controls can be included in district town and country planning schemes or through the Soil Conservation and Rivers Control Act. (Baker-FRC)
W83-01685

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SPURIOUS ADSORPTION EFFECTS IN HEADSPACE-GAS DETERMINATION OF HYDROCARBONS IN WATER,
Ceskoslovenska Akademie Ved, Brno. Ustav Analyticke Chemie.
J. Drozd, J. Vejrosta, J. Novak, and J. A. Jonsson,.
Journal Chromatography, Vol 245, No 2, p 185-192, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Water analysis, *Hydrocarbons, *Adsorption, *Benzene, Hexane, Heptane, Octane, Organic compounds, Trace levels, *Analytical techniques, *Pollutant identification.

The adsorption of benzene, hexane, heptane and octane at the phase interfaces in a gas-water system representing those used in static headspace-gas trace analysis was investigated. The apparent bulk water-gas distribution constants, calculated from the known total amounts of the model solutes and their gas-phase contents determined analytically; true bulk water-gas distribution constants, determined directly by analysis of both the aqueous and gaseous phases; and water surface-gas adsorption distribution constants, calculated from the solute mass balance, are presented and discussed. Adsorption Phenomena were shown to play a significant role with alkanes in gas-aqueous liquid systems. Thus care must be exercised when attempting to determine liquid-gas distribution constants from the known total amounts of analytes added and their equilibrium gas-phase contents determined analytically. (Baker-FRC)
W83-01411

CENTRAL SYSTEM FOR MONITORING THE QUALITY OF WATER FROM MANY SOURCES,
Research Station for Salmonids, Sunndalsora (Norway).
B. P. Kinghorn.
Progressive Fish-Culturist, Vol 44, No 1, p 30-32, January, 1982. 3 Fig, 2 Ref.

Descriptors: *Sampling, *Water sampling, Aquaculture, Dissolved oxygen, Oxygen, *Pollutant identification, Monitoring, *Water quality monitoring..

A water monitoring system was developed to collect samples from up to 35 sources (fish tanks or water supply sources) and deliver them one at a time for analysis of dissolved oxygen and dissolved organic carbon and automatic recording and processing of data. By using different probes and meters the apparatus may be adapted to monitoring pH, salinity, ammonia, and other water properties. This apparatus is operated by gravity flow, but may be equipped with a peristaltic pump if desired. The sampler, about 41 x 41 x 38 cm, contains a 35-tooth ratchet wheel driven by an electric motor. Photocells activate recording equipment and an electric counter. The apparatus has operated reliably for over 6 months. (Cassar-FRC)
W83-01424

AN ASSESSMENT OF THE POTENTIAL OF MAJOR MEIOFAUNA GROUPS FOR MONITORING ORGANIC POLLUTION,
Aberdeen Univ. (Scotland). Dept. of Zoology.
D. Raffaelli.
Marine Environmental Research, Vol 7, No 2, p 151-164, 1982. 10 Fig, 3 Tab, 25 Ref.

Descriptors: *Organic compounds, *Water pollution control, *Biomonitoring, Copepods, Turbellarians, Nematodes, *Meiofauna, Archiannelids, Oligochaetes, Gastrotrichs, Sand, Marine sediments, Indicators, *Scotland, Beaches, Harbors.

The numbers of six meiofauna groups were estimated from 17 sandy beaches differing in their organic (sewage) pollution loadings. The groups included nematodes, copepods, turbellarians, archiannelids, oligochaetes and gastrotrichs. The most abundant species on polluted and fine sand beaches were the nematodes, while copepods were more common on coarse sand and rare on polluted beaches. It is suggested that the ratio of nematodes to copepods may therefore be a useful index of beach quality. Archiannelids and oligochaetes seem restricted to particular habitat types and, with the turbellarians, have little potential for biomonitoring. Gastrotrichs occurred in large numbers on one polluted beach. The major problem associated with the use of meiofaunal groups for biomonitoring is the effect of beach particle size on the abundance of the groups. (Baker-FRC)
W83-01429

BIOASSAY OF THE TOXICITY OF NATURAL AND EFFLUENT WATERS USING CULTURES OF PROTOZOA,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
A. O. Grozdov, S. A. Patin, and S. A. Sokolova.
Hydrobiological Journal, Vol 17, No 4, p 52-56, 1981. 1 Fig, 3 Ref.

Descriptors: *Cultures, *Bioassays, *Protozoans, Biomonitoring, Water quality, Water pollution control, Metals, Mercury, Cadmium, Lead, Zinc, Copper, Organic compounds, Pollutant identification, Toxicity.

Data are presented on the use of protozoan cultures in bioassays for water pollutants. A procedure is proposed for culturing protozoans (Euplotes harpac and Stylonichia mytilis), as well as a method for their isolation from the natural environment. Toxicology experiments and methods of processing and interpreting the data thereby obtained are described. Recommendations are made on the use of data obtained from such bioassays. The practical application of the method has been seen in studying the toxic effects of many metals, including mercury, copper, lead, zinc, and cadmium. As for organic compounds including petroleum and petroleum products, DDT, and PCBs there was no noticeable change in survival in organisms exposed to these substances for a few days. It is possible, however, that in the future it will be possible to increase the sensitivity of the method. (Baker-FRC)
W83-01443

THE AMERICAN OYSTER AS A COASTAL ZONE POLLUTION MONITOR: A PILOT STUDY,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
G. I. Scott, and D. R. Lawrence.
Estuaries, Vol 5, No 1, p 40-46, March, 1982. 1 Fig, 3 Tab, 35 Ref.

Descriptors: *Oysters, *Bioindicators, *Condition Index, Indicators, Coastal waters, Monitoring, Pollutant identification, Water pollution effects, Coliforms, Bacteria, Estuaries, Little River Inlet Estuary, North Inlet Estuary, *South Carolina.

The Condition Index (dry meat weight in g x 100/ internal cavity volume in ml) was determined in the American oyster, Crassostrea virginica, from two South Carolina estuaries, one polluted and one unpolluted. Mean Condition Indexes for oysters collected in late spring, mid-summer, and early fall of 1975 were 3.7-5.0 in the polluted Little River Inlet Estuary and 5.8-11.3 in the unpolluted North Inlet Estuary. Condition indexes decreased from 5-11 at zero total coliforms to 4.5 at 100 coliforms per 100 ml and to < 4 at higher bacterial levels. These results suggest that the Condition Index of oysters is a reliable indicator of pollution in coastal zone areas. (Cassar-FRC)
W83-01444

SATURATOR SYSTEM FOR GENERATING TOXIC WATER SOLUTIONS FOR AQUATIC BIOASSAYS,
Environmental Research Lab., Duluth, MN.
G. L. Phipps, G. W. Holcombe, and J. T. Fiandt.

Progressive Fish-Culturist, Vol 44, No 2, p 115-116, April, 1982. 1 Fig, 5 Ref.

Descriptors: *Bioassay, *Solubility, *Pesticides, Organic compounds, Toxicity, Insecticides, Mixing, *Saturator systems, Pollutant identification.

A saturation device for dissolving low-solubility toxic materials used in aquatic bioassays was built from a 5 gallon stainless steel soda carbonation vessel of the type used in automatic vending machines. It was fitted with a metering pump, magnetic stirring device, and a filter to prevent undissolved material from leaving the vessel. The saturator system functioned well for compounds both lighter and heavier than water and for solids, semi-liquids, and liquids. The coefficients of variation in water samples analyzed daily during 96 hour acute exposure tests were: pentachloroethane, hexachlorobutadiene, 1,1'2-trichloroethylene, 1,3-dichloropropane, and dursban, 2-10%; tetrachloroethylene, 1,1'2-trichloroethane, kelthane, and disulfoton, 11-20%; 1,1',2,2'-tetrachloroethane, 1,2-dichloropropane, hexachloroethane, pydrin, and permethrin, 21-30%; and 1,2-dichloroethane, 33.2%. The completely closed system prevented escape of volatile compounds into the atmosphere. Cleaning was simple and fast. (Cassar-FRC)
W83-01445

ARSENIC, NITRATE, IRON, AND HARDNESS IN GROUND WATER, CHENA HOT SPRINGS ROAD, STEELE CREEK ROAD, AND GILMORE TRAIL AREAS, (T.1N., R.1E., FM), FAIRBANKS, ALASKA,
Geological Survey, Fairbanks, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W83-01516

PROCEEDINGS: SECOND SYMPOSIUM ON PROCESS MEASUREMENTS FOR ENVIRONMENTAL ASSESSMENT, FEBRUARY 25-27, 1980,
Little (Arthur D.), Inc., Cambridge, MA.
P. L. Levins, J. C. Harris, and K. D. Drewitz.
Environmental Protection Agency Project Summary EPA-600/S9-81-018, June 1982. Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina. 5 p.

Descriptors: *Symposium, *Sampling, *Wastewater analysis, *Water analysis, *Bioassay, *Chemical analysis, Coal conversion, Process water, Water pollution, Environmental quality, Sorbents, *Pollutant identification.

This report is a summary of the proceedings of the Second Symposium on Process Measurements for Environmental Assessment held in Atlanta, GA, February 25-27, 1980. The symposium focused on the state-of-the-art of sampling and analysis techniques that are appropriate for process measurements in the context of an environmental assessment program. It included methods for qualitative and quantitative chemical characterization of organic and inorganic species in process and discharge streams and biological assays of environmental samples. The symposium represents a continuing effort on the part of the Process Measurements Branch of the EPA's Industrial Environmental Research Laboratory at Research Triangle Park, NC, to share recently developed methodology and encourage the interchange of ideas among researchers in government, industry and academia. Topics included: use of sorbents for sampling; sampling of reactive species; sampling and analysis methodology for coal conversion processes; advanced inorganic analysis techniques; advanced organic analysis techniques; application of bioassay methods to complex samples. The interchange of information was accomplished through the presentation of 22 papers and through a poster session. (Moore-SRC)
W83-01557

DETERMINATION OF NITROAROMATIC COMPOUNDS AND ISOPHORONE IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Battelle-Columbus Labs., OH.
K. H. Shafer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-208398, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-024, June 1982. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 7 p, 3 Tab.

Descriptors: *Nitroaromatic compounds, *Wastewater analysis, *Dinitrotoluene, *Isophorone, *Nitrobenzene, *Gas chromatography, Nitrogen compounds, Aromatic compounds, Industrial wastewater, Municipal wastewater, *Pollutant identification.

A gas chromatographic method was developed for the determination of nitrobenzene, 2,4- and 2,6-dinitrotoluene (DNT), and isophorone in wastewaters. The components of interest are readily chromatographed on OV-17 using electron capture detection for 2,4- and 2,6-DNT and the flame ionization detection for isophorone and nitrobenzene. In order to determine precision and accuracy, the final method was applied to several representative wastewaters spiked with the compounds at appropriate levels, as well as to surface water. For a wastewater sample spiked with 96 ppb of nitrobenzene, 560 ppb isophorone, and 8 ppb 2,4-DNT, and 7 ppb 2,6-DNT, recoveries were 70 + or - 6% for nitrobenzene, 71 + or - 5% for isophorone, 70 + or - 2% for 2,4-DNT, and 78 + or - 1% for 2,6-DNT. Minimum detectable levels (MDLs) in this wastewater are estimated to be 5 ppb for nitrobenzene, 5 ppb for isophorone, and 0.05 ppb for 2,4- and 2,6-DNT. However, caution must be used in presuming these MDLs are accurate for other wastewaters since several wastewater were encountered which exhibited high levels of interfering compounds. For some complex wastewaters, it may be necessary to apply additional clean up procedures or more selective analytical detection systems in order to achieve these levels of sensitivity. (Moore-SRC)
W83-01564

ANALYTICAL METHODS FOR HAZARDOUS ORGANICS IN LIQUID WASTES FROM COAL GASIFICATION AND LIQUEFACTION PROCESSES,
University of Southern California, Los Angeles.
T. F. Yen, J. I. S. Tang, M. Washburne, and S. Cohanim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-208273, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-038, June 1982. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 6 p, 1 Fig, 11 Tab, 6 Ref. R 806167-01-1.

Descriptors: *Industrial wastewater, *Coal gasification, *Coal liquefaction, *Hydrocarbons, *Phenols, *Nitrogen compounds, *Wastewater analysis, Mutagens, Chromatography, Spectrometry, Organic compounds, Hazardous materials, *Pollutant identification.

The first phase of a project to develop a protocol for identifying and quantifying hazardous organic chemicals present in the wastewaters of coal gasification and liquefaction plants consisted of development of a qualitative scheme including chromatographic separation, total organic carbon determination, infrared spectrometry (IR), gas chromatography and mass spectrometry (GC-MS). An additional task of testing coal liquids, the raw end products of coal liquefaction, for mutagenicity was carried out. Minimal mutagenicity was found in three out of four water extracts taken from coal liquids. The second phase consisted of the quantitation of the compounds detected in the wastewaters. Twenty hazardous organic chemicals named in the priority pollutant list were detected in varying quantities in the wastewaters. Polynuclear aromatic hydrocarbons were found to be present in concentrations yielding gram quantities in daily operation of an average pilot plant. Nitrogenous compounds were present at the same level, and one in particular, N-nitrosodimethylamine, was present at kilogram levels daily. Phenol was present in concentrations high enough to be potentially recoverable economically. Phenolic compounds were the most predominant organic species found. Method development incorporated the use of macroreticular resins for the initial separation of the organics in the wastewaters, sensitive GC-MS and IR identification, and quantitative computer matching mass spectra. (Moore-SRC)
W83-01565

DETERMINATION OF PESTICIDES AND PCBS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Southwest Research Inst., San Antonia, TX.
J. D. Millar, and R. E. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-214222, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-023, June 1982. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 6 p, 3 Tab.

Descriptors: *Wastewater analysis, *Polychlorinated biphenyls, *Halogenated pesticides, *Gas chromatography, Industrial wastewater, Municipal wastewater, Chlorine compounds, Pesticides, Residual chlorine, *Pollutant identification.

Steps in the procedure for the analysis of 25 chlorinated pesticides and polychlorinated biphenyls were studied. Two gas chromatographic columns and two detectors, electron capture and Hall electrolytic conductivity, were evaluated. Extractions were performed with two solvents- dichloromethane and 15% dichloromethane in hexane-at three pHs to determine extraction efficiencies. The effects of storage for seven days, in the presence of residual chlorine, at two temperatures were determined. Florisil and alumina were compared as adsorbents for the clean up of extracts. Recoveries of the substances from clean water and wastewater were measured, and assessments of accuracy and precision were made. The method is satisfactory for the analysis of clean waters and wastewaters having a relatively low background of interferences. However, it does not work well against medium to high levels of background interferences produced by substances that are electron capture sensitive, especially halogenated ones. Use of the Hall detector is indicated when nonhalogenated electron capture sensitive interferences are a problem, even though some loss in sensitivity will occur. When halogenated interferences are overwhelming, altered gas chromatography conditions and columns, such as temperature programming and columns which produce better resolution than the ones studied in this work, will be required.
W83-01566

DETERMINATION OF TCDD IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
California Analytical Lab., Sacramento.
A. S. Wong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-196882, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-028, June 1982. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 5 p, 1 Fig, 7 Tab.

Descriptors: *Wastewater analysis, *Chlorinated compounds, *Gas chromatography, *Mass spectrometry, Industrial wastewater, Municipal wastewater, Herbicides, Residual chlorine, Chlorination, Sample preservation, *Pollutant identification.

This program was undertaken in an effort to develop an analytical method for the determination of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in industrial and municipal wastewaters. The method includes the extraction of TCDD with methylene chloride, cleanup with columns and quantitative determination with gas chromatography (electron capture detector) and gas chromatography/mass spectrometry. The detection limit was found to be 0.003 micro g/l. In conjunction with the development of the analytical method, studies to determine

the optimum conditions for water sample storage were also conducted by evaluating the effects of pH and residual chlorine. The stability of TCDD in organic solvents such as benzene, acetone and methanol was also studied to determine the shelf life of both the standard and extract solutions. It was found that TCDD solutions prepared in benzene, acetone and methanol remained stable during both cold storage and at room temperature. However, degradation of TCDD in water was observed as a result of chlorination followed by prolonged storage. The loss of TCDD in chlorinated water suggests that water samples should be extracted and analyzed as soon as possible unless a non-reactive preservative can be found. (Moore-SRC)
W83-01567

DETERMINATION OF NITROSAMINES IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Southwest Research Inst., San Antonio, TX.
J. W. Rhoades, R. E. Thomas, and D. E. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199621, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-016, May 1982. Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 6 p, 4 Tab.

Descriptors: *Wastewater analysis, *Nitrosamines, *Gas chromatography, Industrial wastewater, Municipal wastewater, Sample preservation, Residual chlorine, *Pollutant identification.

The procedural steps of sample preservation, extraction, cleanup of extracts, and gas chromatographic separation and detection in the analysis of the three N-nitrosamines (N-nitrosodimethylamine, N-nitrosodipropylamine, and N-nitrosodiphenylamine) were studied. Two gas chromatographic columns and three detector systems (alkali flame ionization, thermal energy analyzer, and Hall electrolytic conductivity) were evaluated. Extractions were performed with dichloromethane from salt saturated and nonsalted samples at three pH levels to determine extraction efficiencies. The effects of storage for seven days in the presence of residual chlorine and at two temperatures were determined. Florisil and alumina were compared as adsorbents for the cleanup of extracts. Recoveries of the substances for clean water and wastewater were measured, and assessments of accuracy and precision were made. Nitrosodimethylamine and nitrosodipropylamine can be gas chromatographed very well. Nitrosodiphenylamine is thermally degraded in the injector. The overall benefit of salting does not appear to be sufficient to warrant salting as a routine step. The pH in the range of 2 to 10 had essentially no effect on extraction efficiency of any of the three nitrosamines. The nitrosamines can be determined at concentrations of a few tenths of a microgram per liter for both clean water and wastewaters with each detection system, except nitrosodiphenylamine, which cannot be determined by the thermal energy analyzer. The stability of some of the nitrosamines in wastewater may be poor even under the best storage conditions. (Moore-SRC)
W83-01568

BIO-OPTICAL CLASSIFICATION AND MODEL OF NATURAL WATERS. 2,
Scripps Institution of Oceanography, La Jolla, CA.
K. S. Baker, and R. C. Smith.
Limnology and Oceanography, Vol 27, No 3, p 500-509, May, 1982. 8 Fig, 4 Tab, 45 Ref.

Descriptors: *Natural waters, *Biological properties, Water properties, Measuring instruments, Model studies, *Organic matter, *Dissolved solids, Limnology, Transparency, Attenuation, Phytoplankton, Light, *Optical studies, Radiation.

A bio-optical classification model is outlined which provides systematic order to a wide range of experimental spectral irradiance data. The technique allows both the classification and optical modeling of natural waters. The spectral diffusion attenuation coefficient for irradiance (300-700 nm) has been related to two biological quantities: the total concentration of chlorophyll-like pigments and the dissolved organic material (DOM). The model is a component model which augments previous work in that it includes new data in the analysis, uses an improved analytic fit, extends into the UV region of the spectrum, and adds a DOM component. The model, which permits quantitative calculation of spectral irradiance at any point in the water column in a variety of nonterrigenous water types, facilitates predictive modeling. (Baker-FRC)
W83-01594

PRECONCENTRATION OF COPPER, CADMIUM, MERCURY AND LEAD FROM SEA AND TAP WATER SAMPLES ON A DITHIOCARBAMATECELLULOSE DERIVATIVE,
Dalhousie Univ., Halifax (Nova Scotia). Trace Analysis Research Centre.
R. S. S. Murthy, and D. E. Ryan.
Analytica Chimica Acta, Vol 140, No 1, P 163-169, 1982. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Water analysis, *Trace metals, *Preconcentration, *Copper, *Cadmium, *Mercury, *Lead, Seawater, Drinking water, Potable water, Dithiocarbamatecellulose, Ethylenediamine, 2,2'-Diaminodiethylamine, Triethylenetetramine, *Pollutant identification.

Ethylenediamine, 2,2'-diaminodiethylamine, and triethylenetetramine (trien) were introduced into microcrystalline cellulose after tosylation. Dithiocarbamate (DTC) groups were introduced by reaction with carbon disulfide. The metal uptake behavior of these amine- and dithiocarbamate-cellulose derivatives were compared for Cu(II), Cd(II), PB(II), Hg(II), Co(II), and U(VI). The trien-DTC-cellulose was used to preconcentrate Cu(II), Cd(II), Hg(II), and Pb(II) from sea and tap water. Attempts to introduce amine and dithiocarbamate groups onto filter paper circles via tosylcellulose were not successful, as the circles dsintegrated on reaction with p-toluenesulfonly chloride in pyridine. However, these results show that introduction of dithiocarbamate groups on microcrystalline cellulose via tosylation is simple, inexpensive, and useful for preconcentration from natural water samples. (Baker-FRC)
W83-01641

THEORETICAL ASPECTS OF THE DIRECT TITRATION OF NATURAL WATERS AND ITS INFORMATION YIELD FOR TRACE METAL SPECIATION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
I. Ruzic.
Analytica Chimica Acta, Vol 140, No 1, p 99-113, 1982. 5 Fig, 11 Ref.

Descriptors: *Water analysis, *Trace metals, *Titration, Natural waters, *Copper, Metals, Speciation, *Pollutant identification.

A new method for interpretation of direct titration of natural waters with trace metals is described based on a graph of the ratio between the free and bound metal concentration vs. the free concentration. The application of this method, which is based on a 1:1 complex formation model, is discussed with respect to trace metal speciation in natural waters. Procedures for interpretation of experimental results are proposed for cases in which two types of complexes with different conditional stability constants are formed, or where the metal is adsorbed on colloidal particles. The advantages of the proposed method in comparison with earlier methods are presented theoretically and illustrated with some experiments on copper (II) in seawater. The limitations of the method are also discussed. (Baker-FRC)
W83-01642

CHLOROPHYLL--A RAW WATER QUALITY PARAMETER,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Journal of the American Water Works Association, Vol 74, No 9, p 490-494, September, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Chlorophyll, *Water analysis, *Eutrophication, *Pollutant identification, Water quality, Intakes, Reservoirs, Taste, Odor, *Water treatment.

Chlorophyll measurement is proposed as a cheaper, faster method than algal counting for evaluating raw water quality for water treatment plants. A simplified version of the method for chlorophyll analysis, described in 'Standard Methods', is presented. A water company can develop correlations between chlorophyll levels and various eutrophication parameters such as algae, tastes and odors, trihalomethane content, length of filter runs, activated carbon usage, and chlorine demand. It is likely that good correlations between chlorophyll and some parameters may be obtained only during limited seasons of the year. Data should be accumulated for three years before discarding a parameter as unusable. Each water supply has its characteristic relationship between chlorophyll and other parameters. Chlorophyll measurements may also be used in locating the best position of a water intake with respect to water quality and in eliminating taste and odor problems. (Cassar-FRC)
W83-01657

CONCENTRATION, FRACTIONATION AND CHARACTERIZATION OF SOLUBLE ORGANIC PHOSPHORUS IN RIVER WATER ENTERING LOUGH NEAGH,
Ministry of Agriculture, Belfast (Northern Ireland). Agricultural and Food Chemistry Research Div.
R. J. Stevens, and B. M. Stewart.
Water Research, Vol 16, No 11, p 1507-1519, November, 1982. 11 Fig, 2 Tab, 45 Ref.

Descriptors: *Phosphorus, *Separation techniques, *Pollutant identification, *Organic compounds, *Eutrophication, *Algal growth, *Chromatography, *Infrared spectroscopy, Phosphorus compounds, Rivers, Algae, Humic acids, Bioassay, Precipitation, *Northern Ireland, Lough Neagh, Eutrophic lakes.

An absorption-precipitation technique using lanthanum was used to concentrate organic phosphorus in water samples from six major rivers which feed the Lough Neagh of Northern Ireland. Of the soluble organic phosphorus concentrates obtained from river water samples, 25% was acid-soluble and 40% was subsequently alkali-soluble. The concentrated solutions were fractionated by gel filtration chromatography on Sephadex columns. Of the acid-soluble organic phosphorus, 40% was of molecular weight $>$ 10,000, 2% between 10,000 and 1500, and 40% $<$ 1500. Of the alkali-soluble organic phosphorus, 70% was of molecular weight $>$ 50,000. Infrared spectroscopic analyses revealed the presence of humic substances in the alkali-soluble organic fraction with molecular weight $>$ 50,000. It was hypothesized that phosphorus may be an integral part of the humic acid structure or that an organic phosphorus-metal-organic matter complex may exist. Algal bioassays showed that 10% of the acid-soluble organic phosphorus with molecular weight $>$ 10,000 and 32% of the alkali-soluble organic phosphorus with molecular weight $>$ 50,000 were available for growth under the test conditions. (Geiger-FRC)
W83-01731

5B. Sources Of Pollution

POLLUTION BY ARSENIC IN GOLD-MINING DISTRICT IN NOVA SCOTIA,
Massey Univ., Palmerston North (New Zealand). Dept. of Chemistry, Biochemistry and Biophysics.
For primary bibliographic entry see Field 5C.
W83-01417

EFFECTS OF LENGTH, LOCALITY AND TISSUE TYPE ON MERCURY AND CADMIUM CONTENT OF THE COMMERCIAL SCALLOP, PECTEN-ALBA TATE, FROM PORT-PHILLIP BAY, VICTORIA,
Victoria Ministry for Conservation, Melbourne (Australia). Fisheries and Wildlife Div.
T. I. Walker, J. W. Glover, and D. G. M. Powell.

Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 547-552, 1982. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Water pollution sources, *Heavy metals, *Fate of pollutants, *Mollusks, *Bioaccumulation, *Spatial distribution, Bays, *Mercury, *Cadmium, Industrial wastes, Domestic wastes, Farm wastes, Mine wastes, Animal tissues, *Australia.

Concentrations of total mercury (Hg) and total cadmium (Cd) were determined by atomic absorption spectroscopy in samples of the commercial scallop, Pecten alba Tate, taken from Port Phillip Bay. Results were dependent upon the type of tissue analyzed, sampling site, and to a lesser extent, on the size of the scallops. Mean Hg concentrations were 0.04 micrograms/g (wet weight) in viscera, 0.02 micrograms/g in adductor muscle, and 0.02 micrograms/g in gonads. Mean Cd concentrations were 7.7 micrograms/g in viscera, 1.0 micrograms/g in adductor muscle and 0.9 micrograms/g in gonads. Hg levels in samples from Port Phillip Bay tended to decrease from north to south and also from east to west. The distribution of Hg in the bay may be related to early mining activities in the catchment, past and present agricultural, industrial and domestic wastes, and the general behavior of Hg in both the biotic and abiotic components of the environment. Cd trends were not as well defined, but concentrations in the northern region were generally higher than those in the southern region. (Geiger-FRC)
W83-01418

EFFECTS OF SEPTIC TANK SYSTEMS ON ENVIRONMENTAL QUALITY,
ADI Ltd., Fredericton (New Brunswick).
T. Viraraghavan.
Journal of Environmental Management, Vol 15, No 1, p 63-70, 1982. 4 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Septic tanks, *Environmental effects, Sludge disposal, Fate of pollutants, Water quality, Nitrogen, Phosphorus, Nutrients, Reviews, Microorganisms, Pathogens, Bacteria, Viruses, Nitrates, Phosphates, Land application, Land disposal, Composting.

The environmental effects of septic tanks are reviewed. Effluent, containing solids, nitrogen and phosphorus nutrients, microorganisms, and viruses, can affect water quality if systems fail. Nitrogen, predominantly ammonia, is oxidized in aerobic soils to nitrates, which should not exceed 10 mg per liter in drinking water. Phosphates, usually fixed in the soils by adsorption and other processes, are generally not transported to water bodies or groundwater in excessive quantities. It is unwise to establish codes for siting septic tanks (usually 15-30 m separation between the leaching system and drinking water wells) without considering the local site conditions. The fate of viruses in on-site disposal systems is not yet clearly defined. However, factors enhancing adsorption also enhance virus removal. although viruses do not reproduce in soil, they can persist up to 6 months in soil. Septage, the accumulated sludge and scum periodically removed from septic tank systems, can greatly affect the environment if applied untreated or with minimal treatment to land. Treatment in municipal plants or by composting greatly decreases impact on groundwater quality. (Cassar-FRC)
W83-01438

THE LOCH EIL PROJECT: SEDIMENT CHEMISTRY, SEDIMENTATION AND THE CHEMISTRY OF THE OVERLYING WATER IN LOCH EIL,
Dunstaffnage Marine Research Lab., Oban (Scotland).
S. O. Stanley, J. W. Leftley, A. Lightfoot, N. Robertson, and I. M. Stanley.
Journal of Experimental Marine Biology and Ecology, Vol 55, No 2/3, p 299-313, 1981. 5 Fig, 6 Tab, 23 Ref.

Descriptors: *Pulp and paper industry, *Organic matter, *Sedimentation, Fate of pollutants, Cellulose, Tidal effects, Sediments, Estuaries, Sulfides, Nutrients, Loch Eil, *Scotland, Fjords.

Sedimentation and the input of pulp fibers on sediment chemistry were studied during 1976 in Loch Eil, Scotland. Sedimentation rates varied seasonally and among stations. Highest rates were generally observed at the stations closest to a paper mill discharge. The percentage of cellulose in sedimenting material was 1.9% in September, 15.7% in January, and 19.5% in October. Experiments in 1978 showed that sedimentation rates also varied with tides. In spring tides sedimentation rates were highest during high water and lowest during low water. In neap tides there was little difference over the tidal cycle or throughout the water column. This suggests that sedimentation measurements made at neap tides are more representative. Loch Eil sediments were higher in carbon and had higher carbon:nitrogen ratios than at control stations in the Lynn of Lorne. Sediment from stations nearest the paper mill had higher sulfide levels and more reduced conditions than the control and stations further from the mill. Nitrate and ammonia concentrations did not vary markedly among stations within Loch Eil. (Cassar-FRC)
W83-01439

THE LOCH EIL PROJECT: EFFECT OF ORGANIC MATTER INPUT ON INTERSTITIAL WATER CHEMISTRY OF LOCH EIL SEDIMENTS,
Dunstaffnage Marine Research Lab., Oban (Scotland).
L. G. Duff.
Journal of Experimental Marine Biology and Ecology, Vol 55, No 2/3, p 315-328, 1981. 7 fig, 4 Tab, 20 Ref.

Descriptors: *Organic matter, *Pulp and paper industry, *Sediments, Water pollution effects, Fate of pollutants, Loch Eil, *Scotland, Cellulose, Estuaries, Sedimentation, Interstitial water, Sulfides, Iron compounds, Anaerobic conditions, Degradation, Biodegradation, Sulfates, Fjords.

Interstitial water profiles were examined in two stations in Loch Eil, Scotland. Station E70 received a high input of cellulose fibers from a pulp and paper mill; Station E24 was less severely affected by the mill effluent. Sedimentation rates were 0.6 and 0.8 cm per year for E24 and E70, respectively. Sulfate levels in interstitial water increased with depth in a fluctuating manner in the first 10 cm of sediments and decreased with further increases in sediment depth. E70 had lower sulfate concentrations at the 35 cm depth than E24. Sulfate levels were lower in winter than in summer. Alkalinity and ammonia concentrations increased with sediment depth at both stations and were higher at E70. Cellulose decreased between 0-1 and 5-10 cm depths by 2.5% at E24 and 31.5% at E70. Solid sulfide concentrations in interstitial water in the top 10 cm of sediments were higher at E70 (150-100 micro mol per g dry weight). Ferrous iron concentrations at 2 cm depth generally were higher at E24 than at E70, with average maxima of 250 and 174 micro mol, respectively. (Cassar-FRC)
W83-01440

EFFECT OF BROWN BULLHEADS ON RELEASE OF PHOSPHORUS IN SEDIMENT AND WATER SYSTEMS,
State Univ. of New York at Cortland. Dept. of Biological Sciences.
W. H. Keen, and J. Gagliardi.
Progressive Fish-Culturist, Vol 43, No 4, p 183-185, October, 1981. 2 Fig, 12 Ref.

Descriptors: Fish, Sediments, *Phosphorus, Adsorption, Lakes, *Lake sediments, Metabolism, Path of pollutants, *Bullhead.

The concentration of soluble reactive phosphorus (DRP) was studied for 34 days in laboratory tanks containing water with added: (1) fish and sediment, (2) fish, and (3) sediment. Highest levels (over 250 micrograms per liter phosphate-P) were found in tanks with fish and no sediment; lowest levels (nearly zero) in tanks with sediment and no fish. Systems with sediment and fish contained about 10 micrograms per liter phosphate-P. The phosphates produced from fish physiological processes were apparently adsorbed by sediments. The burrowing and sediment mixing activities of the brown bullheads used in the study probably facilitated the sorption of phosphates onto the sediments. (Cassar-FRC)
W83-01446

REPORT ON QUALITY OF WATERSHED DATA FROM THE HAWAII SMALL WATERSHED PROJECT,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7A.
W83-01465

REPORT ON QUALITY OF PLOT AND SMALL WATERSHED HYDROLOGIC DATA FROM THE SOUTHERN PIEDMONT CONSERVATION RESEARCH CENTER,
For primary bibliographic entry see Field 7A.
W83-01466

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE AGRICULTURAL/SURFACE-MINED HYDROLOGY RESEARCH GROUP, FORT COLLINS, COLORADO,
For primary bibliographic entry see Field 7A.
W83-01468

REPORT ON QUALITY OF PESTICIDE RUNOFF DATA FROM THE SOIL AND WATER MANAGEMENT RESEARCH UNIT, RIVERSIDE, CA,
For primary bibliographic entry see Field 7B.
W83-01469

PHOSPHORUS LOADING TO A MOUNTAIN RESERVOIR IN SOUTHERN CALIFORNIA,
New York State Museum, Albany.
C. A. Siegfried.
Water Resources Bulletin, Vol 18, No 4, p 613-620, August, 1982. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Reservoirs, *Phosphorus, *Nutrients, Nitrogen, Eutrophication, Eutrophic lakes, *California, Big Bear Lake.

Phosphorus loading was examined for more than a dozen tributaries of Big Bear Lake, a high mountain reservoir in Southern California. Nitrogen as well as phosphorus loading relationships were determined for each subbasin. Differences in loading relationships were related to various subbasin characteristics such as precipitation, geology, and development. Phosphorus loading is then utilized in the evaluation of the trophic status of the lake and its prospects for restoration. Big Bear Lake is currently eutrophic and is likely to remain so. Calculations based on Vollenweider's critical phosphorus loading concept indicate that tributary P-loading would have to be reduced by more than 95% to achieve mesotrophic conditions. The completion of Big Bear Dam created a naturally eutrophic reservoir which will require proper management to enhance its resource potential. (Baker-FRC)
W83-01504

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA, PHASE 2--EFFECTS OF PUMPING ON WATER LEVELS AND WATER QUALITY IN THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W83-01513

GROUND-WATER QUALITY IN THE VICINITY OF LANDFILL SITES, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2F.
W83-01521

MODELLING NITRATE CONCENTRATION IN SOME UNITED KINGDOM RESERVOIRS,
Water Research Centre, Slevenage (England).
D. Johnson, and J. M. Davis.
Canadian Water Resources Journal, Vol 7, No 1, p 319-336, 1982. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Reservoirs, *Nitrates, *Model studies, Mathematical equations, Seasonal variations, *England, Inflow.

A simple mathematical model has been shown able to reproduce the seasonal variation of nitrate in offchannel storage reservoirs. Tests using data from three different lowland reservoirs in the United Kingdom suggest that each reservoir can be modeled using the same biological removal rates without any significant loss of accuracy. Additional simulations are planned for other reservoirs to investigate this further. The model may be used to study the effects of changes in operating regime of an existing pumped-storage reservoir or to predict the probable nitrate concentration in a proposed new reservoir. In its present form, however, the model will not adequately reproduce the nitrate concentrations during a period of about one year following initial filling. The same problem will occur following a period when the reservoir has been significantly drawn-down and its sediments allowed to dry out. Both these situations represent times when the expected denitrification rates assumed by the model are much greater than reality due to a reduction in normal microbiological activity in the reservoir sediments. (Baker-FRC)
W83-01554

ADSORPTION CHARACTERISTICS OF SESTON IN IRRIGATION WATER: IMPLICATIONS FOR THE USE OF AQUATIC HERBICIDES,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
K. H. Bowmer.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 443-458, 1982, 6 Fig, 6 Tab, 58 Ref.

Descriptors: *Fate of pollutants, *Adsorption, *Seston, *Herbicides, *Water pollution sources, Aquatic drift, Suspended solids, Irrigation districts, Erosion, Sediment transport, Agricultural runoff, *Australia, New South Wales.

Seston (suspended particulate matter) from the turbid waters of Murrumbidgee Irrigation Areas of New South Wales was tested for its adsorption of three aquatic herbicides to elucidate the role of seston in the transport of contaminants by erosion into freshwater systems. Adsorption of terbutryne and glyphosate by seston was generally at least an order of magnitude higher than reported in the literature for soils. However, adsorption of terbutryne by seston is expected to have little effect on the reduction of levels of this herbicide in practice. Phosphate additions reduced adsorption of glyphosate and may account for the differences in adsorbing power observed for seston from different sources. Adsorption by seston was sufficient to completely inactivate diquat in irrigation drainage waters at concentrations up to 0.5 milligrams/liter. After the seston adsorption capacity was saturated, the herbicide could then be effective if sufficient amounts were applied. (Geiger-FRC)
W83-01580

HEAVY METAL ENRICHMENT IN THE SURFACE MICROLAYER OF THE NEPEAN-HAWKESBURY RIVER SYSTEM,
Australian Atomic Energy Commission Research Establishment, Lucas Heights.
R. K. Barnes, G. E. Batley, and J. H. Sharp.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3 p, 417-430, 1982, 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Heavy metals, Water pollution sources, *Fate of pollutants, Surface water, Physicochemical properties, *Thin films, *Copper, Lead, *Cadmium, *Zinc, Subsurface water, Organic carbon, Nitrogen compounds, Films, Air pollution, River systems, *Australia, Nepean-Hawkebury river system.

Trace metal concentrations in the Nepean-Hawkesbury river system near Sydney, New South Wales, were measured in subsurface and surface-film water samples to ascertain the extent of surface enrichment of copper (Cu), cadmium (Cd), lead (Pb), and zinc (Zn). Dissolved organic carbon (DOC), surface pressure, dissolved organic nitrogen (DON), and Cu-complexing capacity were also measured to establish possible correlations between these physicochemical properties and surface enrichment. Positive correlations were noted between measured surface-film pressures and the surface excesses of Pb, Zn and DOC. Good correlations were also observed between the complexing capacity of surface samples and DON. Enriched Zn was present in surface films mainly in bound species, while Pb was enriched in both bound and labile forms. Cu was found mainly as a bound species. The dominance of Pb was enriched in both bound and labile forms. Cu was found mainly as a bound species. The dominance of Pb and Zn in surface films is attributed mainly to airborne deposition from motor fuels of land vehicles and boats. (Geiger-FRC)
W83-01582

APPLICABILITY OF PHOSPHORUS INPUT-OUTPUT MODELS FOR IMPOUNDMENTS WITH HIGH TROPHIC AND HYDRAULIC LOADING (ZUR FRAGE KRITISCHER NAHRSTOFFBELASTUNG GESTAUTER FLIESSGEWASSER. GRENZEN DER UBERTRAGBARKEIT DER FUR SEEN UND TALSPERREN KONZIPIERTEN MODELLE),
Ruhrverband, Essen (Germany, F.R.) Chemisches und Biologisches Lab.
For primary bibliographic entry see Field 5C.
W83-01583

DIFFERENCES IN ANIMAL 13C, 15N, AND D ABUNDANCE BETWEEN A POLLUTED AND AN UNPOLLUTED COASTAL SITE: LIKELY INDICATORS OF SEWAGE UPTAKE BY A MARINE FOOD WEB,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
G. H. Rau, R. E. Sweeney, I. R. Kaplan, A. J. Mearns, and D. R. Young.
Estuarine, Coastal and Shelf Science, Vol 13, No 6, p 701-707, 1981. 2 Fig, 1 Tab, 35 Ref.

Descriptors: *Coastal waters, *Marine animals, *Food chains, *Carbon-13, Nitrogen-15, Isotopes, Benthos, Wastewater, *California, Wastewater disposal, Prawns, Sole, *Hydrogen Isotopes.

Specimens of Ridgeback prawn and Dover sole were taken from a control station and a sewage-affected station as part of a sampling program. The natural relative abundances of C-13, N-15 and D in Dover sole and Ridgeback prawn muscle were found to be significantly different. This between-site shift in animal isotope abundance is of the type expected if sewage organic materials were an important food source for animals in the latter site. Use of stable isotope natural abundance to trace the incorporation and movement of sewage-derived organics in marine food webs is suggested. (Baker-FRC)
W83-01591

IS THIS THE LAST WORD ON LOVE CANAL.
S. Miller.
Environmental Science and Technology, Vol 16, No 9, p 500A-501A, 1982. 2 Fig.

Descriptors: *Water pollution sources, Environmental effects, *Waste disposal, Monitoring, Leaching, Fate of pollutants, *Love Canal, *New York, Path of Pollutants, Canals, Groundwater pollution, Industrial wastes.

The results of the monitoring program conducted at Love Canal during the summer and fall of 1980 revealed a limited pattern of environmental contamination. Of all the samples taken, fewer than 13% contained any measurable level of contaminants. With the exception of contamination present in storm sewer and creek sediments, the study did not produce evidence that Love Canal has contributed to environmental contamination in the Declaration Area. The hydrogeological study determined that there is no apparent hydraulic connection between the underlying shallow and deep groundwater aquifers. No consistent multimedia pattern of contamination was noted in the Declaration Area directly attributable to migration from Love Canal. Even so, for areas in the vicinity of the Ring 1 houses, those built over the canal itself, toxic chemicals had migrated from Love Canal and had contaminated shallow system groundwater, soil and dumps. No contamination was found in the bedrock aquifer, and only very localized contamination was noted in the shallow system. Storm sewer water analysis and sediment studies revealed that highly contaminated sediment and contaminated water were traceable from Canal Areas to local outfalls. (Baker-FRC)
W83-01592

DYNAMICS OF CARBON AND NITROGEN DURING THE DECOMPOSITION OF DETRITUS DERIVED FROM ESTUARINE MACROPHYTES,
State Univ. of New York at Binghamton.
For primary bibliographic entry see Field 2L.
W83-01595

ORGANIC CARBON TRANSPORT IN THE COLUMBIA RIVER,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
C. N. Dahm, S. V. Gregory, and P. K. Park.
Estuarine, Coastal and Shelf Science, Vol 13, No 6, p 645-658, December, 1981. 7 Fig, 3 Tab, 26 Ref.

Descriptors: *Rivers, *Organic carbon, *Particulate matter, Seasonal variation, *Columbia River, Estuarine environment, Estuaries, Dissolved solids.

Seasonal variations in concentration and partitioning between dissolved and particulate fractions of the organic load of the Columbia River were examined as a reference point for future studies on a basin being increasingly impacted by rapidly growing population, agriculture, and industry. Natural seasonal variability was examined in the concentration and form of organic matter relative to physical parameters of discharge rate and temperature, chemical parameters associated with the carbonate system, and nutrient distributions to provide tools for estimating past and predicting future export of organic matter by the River. Upstream-downstream variability of organic load on the lower 200 km of the river for detectable point source inputs or for an organic carbon decrease due to processing before the estuary was assessed. Finally, the annual organic carbon export for a major river was carefully measured for use in global carbon flux studies and for estimation of riverine input to the estuary and the north-eastern Pacific. Total organic carbon (TOC) levels measured monthly ranged from 270 to 150 micromol/liter. The average annual TOC contribution from the Columbia River drainage to the north-eastern Pacific is 4.9 x 10 to the 10th power mol with an average concentration of about 195 micromol/liter. Of this TOC annual export, 89% is DOC and 11% is particulate organic carbon. Variability of DOC in the main channel from Portland, Oregon to the estuary was minimal. DOC concentrations ranged from 221 to 260 micromol/liter, with no significant upstream or downstream gradients. Diel variation also was slight, varying randomly during 24 hr between 235-257 micromol/liter. (Baker-FRC)
W83-01596

PLUTONIUM AND AMERICIUM EXPORT TO THE NORTH-EAST PACIFIC OCEAN BY COLUMBIA RIVER RUNOFF,
Oregon State Univ., Newport. Marine Science Center.
T. M. Beasley, L. A. Ball, and B. A. Blakesley.
Estuarine, Coastal and Shelf Science, Vol 13, No 6, p 659-669, December, 1981. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Sediment transport, *Plutonium, *Americium, Continental shelf, Pacific Ocean, Coastal waters, Estuaries, Sediments, Chemical analysis, Radioisotopes, Path of pollutants, *Columbia River, Nuclear fuel reprocessing plants.

A series of monthly collections of water samples was made at the mouth of the Columbia River to determine the contemporary annual export rate of both Pu-239,240 and Am-241, with the aim of assessing the importance of riverine input of these radionuclides to their shelf and slope sediment inventories. During this period approximately 70 mCi of Pu-239,240 and 17 mCi of Am-241 were carried by the river to the ocean. From the depositional history of a fine-grained sediment core raised from within the Columbia River estuary an estimated 4-8 Ci of Pu-239,240 and 1-2 Ci of Am-241 have entered the northeast Pacific Ocean by river transport since the late 1950s. This input would have increased the transuranic inventories in adjacent coastal sediments by at most 2.5 times those expected as a result of direct atmospheric fallout. (Baker-FRC)
W83-01597

CONSERVATIVE BEHAVIOUR OF DISSOLVED LITHIUM IN ESTUARINE WATERS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2L.
W83-01598

ATRAZINE DEGRADATION, SORPTION, AND BIOCONCENTRATION IN WATER SYSTEMS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
D. C. Wolf, and R. L. Jackson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150151, Price codes: A03 in paper copy, A01 in microfiche. Publication No 87, August 1982. 45 p, 9 Fig, 7 Tab, 55 Ref.

Descriptors: *Herbicides, *Atrazine, *Fate of pollutants, *Sediments, *Degradation, *Biological magnification, *Pesticide residues, Hydrogen ion concentration, Bacteria, Fungi, Suspended solids, Organic material.

The herbicide atrazine is used extensively to control broadleaf and grass weeds in such crops as sorghum and corn. A small portion of the atrazine may be lost from the area of application by surface runoff and could enter a stream or lake. Once the atrazine enters a water system, the partitioning of atrazine between the aqueous and solid phases of the water-sediment system largely determines the impact of the herbicide on water quality and aquatic ecosystems. The results of studies on water-sediment systems indicated that sediments with lower pH values and higher organic matter levels adsorbed higher levels of atrazine than sediments with neutral pH values and lower organic matter levels. Microbial decompostion of the herbicide was slow. Addition of supplemental carbon sources in the form of glucose or peptone did not appear to influence the rate of atrazine degradation. Bioconcentration of atrazine by fungi and bacteria was demonstrated. The organic component of the suspended particulate matter in a water system may be an active adsorption site. (Moore-SRC)
W83-01607

SALT LOADING FROM EFFLORESCENCE AND SUSPENDED SEDIMENTS IN THE PRICE RIVER BASIN,
Utah Water Research Lab., Logan.
D. S. Bowles, H. Nezafati, B. K. Rao, J. P. Riley, and R. J. Wagenet.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150245, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-82/05, May 1982. 158 p, 59 Fig, 22 Tab, 144 Ref, 3 Append. OWRT B-172-UTAH(1), 14-34-0001-9099.

Descriptors: *Salt efflorescence, *Sodium sulfate, *Suspended sediments, *Salt loading, *Utah, Colorado River, Saline water, Salts, Mathematical models, Storm runoff, Soil chemistry, *Price River Basin.

The Price River Basin is located principally in Carbon and Emery Counties of east-central Utah. The Price River contributes approximately 3% of the salt load of the Colorado River in less than 1% of the water. Salt efflorescence was examined by field observation in the Price River Basin and instrumentation, laboratory experiments, and mathematical modeling. The field data showed near saturation conditions of sodium sulfate waters below crusts of densities between 0.14 and 0.36 g/sq cm and which formed over about a 10-day period following channel cleaning by storm runoff. Laboratory data on salt crusting in soil columns were also used in developing a model which when applied to the Price River Basin estimated that no more than 7.5% of the total salt loading comes from salt efflorescence being carried away in the stream flow. The conditions favorable to the accumulation of salt efflorescence are highly saline water just below the soil surface and a source of heat for vaporizing the water. Salt release from suspended sediments was studied by laboratory experimentation with sediment material obtained from various locations in the Price River Basin. The Buckingham Pi Theorem was employed to derive relationships expressing the EC of a sediment water system as a function of the controlling factors. The results were presented in two salt release equations, one excluding the effect of initial EC and the other providing for initially saline solutions. The salt release equations were incorporated into an adapted version of the Watershed Erosion and Sediment Transport (WEST) model and applied to a small tributary of Coal Creek. Extrapolation to the entire Price River Basin led to an estimate that about 0.50% of the total annual salt load is released from suspended sediments. (Moore-SRC)
W83-01617

A EULERIAN-LAGRANGIAN NUMERICAL SCHEME FOR THE DISPERSION-CONVECTION EQUATION USING CONJUGATE SPACE-TIME GRIDS,
Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.
S. P. Neuman.
Journal of Computational Physics, Vol 41, No 2, p 270-294, June 1981, 11 Fig, 48 Ref. OWRT B-074-ARIZ(2).

Descriptors: *Convection, *Dispersion, *Groundwater movement, *Mathematical analysis, *Radioactive wastes, Groundwater pollution, Prediction, Mathematical equations.

The dispersion-convection equation is widely used to describe Fickian transport of pollutants. Recently, there has been much interest in the possibility of using this equation to predict the effect of groundwater flow on the migration of radionuclides from geological repositories of nuclear waste to the biosphere. This poses a special challenge to the numerical analyst because subsurface transport is often controlled by complex three-dimensional flow patterns which can vary with time, by an anisotrophic dispersion process whose tensorial description depends on the velocity field, and by other complicating linear and nonlinear phenomena. A new numerical scheme is proposed for the dispersion-convection equation which combines the utility of a fixed grid in Eulerian coordinates with the computational power of the Lagrangian method. Convection is formally decoupled from dispersion in a manner which does not leave room for ambiguity. The resulting convection problem is solved by the method of characteristics on a grid fixed in space. Dispersion is handled by finite elements on a separate grid which may, but need not, coincide with the former at selected points in space-time. Information is projected from one grid to another by local interpolation. The conjugate grid method is implemented by linear finite elements in conjunction with piecewise linear interpolation functions and applied to five problems ranging from predominant dispersion to pure convection. The results are entirely free of oscillations. Numeral dispersion exists but can be brought under control either by reducing the spatial increment, or by increasing the time step size, of the grid used to solve the convection problem. Contrary to many other methods, best ressults are often obtained when the Courant number exceeds 1. (Moore-SRC)
W83-01618

NONPOINT SOURCE POLLUTION FROM PCBS: BIOAVAILABILITY AND INACTIVATION WITH ACTIVATED CARBON,
North Carolina State Univ. at Raleigh, Dept. of Crop Science.
J. B. Weber, H. J. Strek, and M. R. Overcash.
In: Toxicology of Halogenated Hydrocarbons, M. A. Q. Khan, Ed, Pergamon Press, Inc., New York 1981, p 364-374, 2 Fig, 8 Tab, 33 Ref. OWRT B-122-NC(7).

Descriptors: *Polychlorinated biphenyls, *Activated carbon, *Nonpoint pollution sources, *Bioaccumulation, *Soil contamination, *Cleanup operations, Chlorinated hydrocarbons, Phytotoxicity, Sediments, Sludge, Environmental effects, Adsorption.

Polychlorinated biphenyls (PCBs) are widely distributed in small amounts in the soils of the U. S., and in moderate to high amounts in the sediments of many rivers and other bodies of water. PCBs in amounts ranging from 50 to 1700 ppm have been found in the sewage sludge of many cities. Isolated cases of PCB spills have resulted in high concentrations of the chemicals in small localized areas. PCBs are nearly immobile in soils due to their very low water solubility and high lipophilicity. The chemicals are absorbed very strongly by soil substituents and do not leach significantly through soil columns. Activated carbon has been found to be a very effective adsorbent for PCBs. Water uptake and growth of plants is inhibited by PCBs in the soil, but activated carbon added to the soil may prevent the phytotoxic action. Uptake and translocation of PCBs by a variety of plants has been demonstrated. Lower chlorinated biphenyls appear to be translocated by plants in higher amounts than highly chlorinated biphenyls. Activated carbon added to the soil reduces PCB uptake by plants up to 100%. (Moore-SRC)
W83-01621

DISTRIBUTION OF MINERAL NITROGEN UNDER NATIVE RANGE AND CULTIVATED FIELDS IN THE NEBRASKA SANDHILLS,
Nebraska Univ., North Platte. Dept. of Agronomy.
G. W. Hergert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150367, Price codes: A04 in paper copy, A01 in microfiche. Nebraska Water Resources Center Report, July 30, 1982. 65 p, 12 Fig, 7 Tab, 5 Ref. 1 Append. OWRT A-061-NEB(1).

Descriptors: *Soil water, *Nitrates, *Groundwater pollution, *Fertilizers, *Irrigation effects, *Leaching, Nebraska, Water quality, Ammonium, Corn, Alfalfa, Grasses, Soil texture, Sand.

Seven different sites were sampled to the water table for soil moisture, nitrate and ammonium content. Three holes per site were taken for averaging the measured parameters over holes by depth. Hole to hole variability at a given depth was not too large in most instances. Variation was greatest in the upper 12 meters due to soil textural differences caused by shifting of sands in the recent geologic past. The irrigation and N fertilizer application history of each site has been documented. Only slight differences between nitrate-N under alfalfa and its adjacent native range were evident. A substantial difference between nitrate-N distributions under the irrigated cool season grass and its adjacent native range was found. The soil under the grass was enriched in nitrate-N compared to the native range to 7 meters. Since the cool season grass was only irrigated 1975-1977 the bulk of the movement probably occurred in 3 years, at an average of 2.2 meters per year. Definite nitrite enrichment under irrigated corn compared to native range was shown to a 15 meter depth. Average movement of a nitrate bulge under the

corn between spring 1980 and spring 1981 was 2.2 meters. For the total 7 years cropping history average rate of N movement was also 2.2 meters per year. This data can provide a good data base for verification of models used to predict nitrate-N movement under various crops grown on deep, very sandy soil. This type of information is needed, along with recharge data to predict future changes in ground water quality for much fo the Nebraska Sandhills now under cultivation.
W83-01632

AN EVALUATION OF THE EFFECTIVENESS OF HYDROGEN AND OXYGEN ISOTOPES USED IN CONCERT WITH CHEMICAL WATER-QUALITY PARAMETERS AS INDICATORS OF SUBSURFACE WATER MOVEMENT AND SOURCE,
Arizona Univ., Tucson. Dept. of Hydrology and Natural Resources.
T. W. Thurnblad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150029, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center Report, September 1982. 141 p, 38 Fig, 37 Ref. 6 Append. OWRT A-103-ARIZ(1).

Descriptors: *Groundwater pollution, *Water pollution sources, *Trace elements, *Isotope studies, *Oxygen isotopes, *Hydrogen isotopes, *Groundwater movement, Arizona, Anions, Cations, Water temperature, Water quality, Computers, Hydrogen ion concentration, Recharge, Mine wastes, Specific conductivity, Arsenic, Fluoride, Sulfate.

A multiuse area, 15 miles south of Tucson, Arizona, was selected to test a water-pollution source assessment technique emphasizing the combined study of stable isotopes of water, major anions and cations, trace elements, pH, specific conductance, and water temperature. Computer-based analytical techniques were developed to identify data patterns indicating effects of recharge sources. A large amount of water chemistry data was generated, and relationships between poor-quality water and potential contamination sources were defined. The range in isotopic ratios along the study transect density and frequency of sampling are sufficient. A pattern showing increasingly heavy delta 0-18 values with decreasing distance from a tailing pond supported inferences based on chemical data that tailings pond leakage may be contaminating downgradient ground water. At some sites, water quality parameters were found to exceed state drinking-water supply standards. High sulfate concentrations were found in the surface water of mine pits and tailings ponds, and in groundwater immediately downgradient. Two ground-water sites exhibited nitrate concentrations in excess of State water-quality standards, and a city domestic supply well east of the Santa Cruz River showed values for both fluoride and arsenic that exceed mandatory State limits. (Moore-SRC)
W83-01633

ASBESTOS ANALYSIS CASE HISTORY: SURFACE WATER SUPPLIES IN SOUTHERN CALIFORNIA,
Southern California Metropolitan Water District, La Verne.
M. J. McGuire, A. E. Bowers, and D. A. Bowers.
Journal of the American Water Works Association, Vol 74, No 9, p 471-478, September, 1982. 11 Fig, 6 Tab, 10 Ref.

Descriptors: *Asbestos, *Sediments, *Mine drainage, Water pollution sources, Fate of Pollutants, Aqueducts, Metropolitan Water District of Southern California, Colorado River Aqueduct, Reservoirs, Sedimentation, Water supply, Coalinga, *California, Mineral industry.

Asbestos fibers were not found in 12 water samples collected in the Metropolitan Water District of Southern California's raw and finished water supplies during a 1974 survey. Subsequent analyses in 1980 detected asbestos at concentrations as high as 15,000 million fibers per liter in some locations of the California aqueduct. Changes in asbestos levels were attributed to operational changes after 1974, resulting in reduced residence times in the lakes. The source of the asbestos fibers is surface runoff from serpentine deposits in the Sacramento River watershed and old asbestos mines east of Coalinga. Natural mechanisms in the lakes and reservoirs appear to remove some asbestos fibers by sedimentation. The sediments (0.57 million cu m) in the adueduct section between Coalinga and Edmonston contained up to 0.005 g chrysotile asbestos per g of sediment. Removal of the sediment by a specially designed dredge began in November 1981. Total asbestos fibers measured in Silverwood Lake on March 21, 1981, were highly variable, from 730 million fibers per liter at the surface near the inlet to 4500 million fibers per liter at 30 m depth near the outlet. Water in the Colorado aqueduct system contained from below detectable limits to 1.6 million fibers of per liter in June 1981 sampling and up to 13 million fibers per liter in March 1981. Asbestos fiber concentrations were not correlated with turbidities and particle counts. (Cassar-FRC)
W83-01655

LOCAL REDISTRIBUTION AND PARTIAL EXTRACTION OF HEAVY METALS IN BOTTOM SEDIMENTS OF AN ESTUARY,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
I. Aoyama, Y. Urakami, and O. Kawara.
Environmental Pollution, Series B: Chemical and Physical, Vol 4, No 1, p 27-43, July, 1982. 9 Fig, 8 Tab, 16 Ref.

Descriptors: *Heavy metals, *Sediments, *Chelation, Fate of pollutants, Metals, Estuaries, Bays, Rivers, Bottom sediments, Mixing, Tidal currents, Kojima Bay, Ashahi River, Yoshii River, Lead, Cadmium, Copper, Zinc, Manganese, Iron, *Japan.

The distribution and speciation of heavy metals in estuarine and bay sediments were studied in Kojima Bay, Japan, and the inflowing rivers, Asahi and Yoshii. The 12 km long, 1-2 km wide bay receives 100,000 cu m per day of domestic and industrial effluents. Suspended solids, chloride, and COD levels in water generally increased from the upper stream to the mouth of the rivers. Concentrations of pollutants were relatively uniform at different stations along the bay but changed with tidal fluctuations. The principal tidal current caused local redistribution of heavy metals in sediments. Analytical results for heavy metals at the 38 sites were: Pb, 3.8-48.0 ppm; Cu, 8.4-74.4 ppm; Zn, 41.0-557 ppm; Mn, 195-1450 ppm; Cd, 0-1.44 ppm; Mg, 1700-13,000 ppm; and Fe, 1.10-4.10%. The water soluble fraction of the metals was $< 1\%$ for Pb, Cd, Zn, Mn, and Fe, and 1.5% for Cu. The unexchangeable fractions extracted by 1 M ammonium acetate were 42% of Cd, 19% of Mn, 8% of Pb, 9% of Zn, 1.1% of Cu, and 0.03% of Fe. The reducible fractions extracted by 0.2 M ammomium oxalate were 5.8% of Pb, 11-15% of Cd, Cu, Zn, and Mn, and 1.7% of Fe. Extractions of 0.01 M ethylenediamine-2Na solution were about 70% of Pb and Cd, about 27% for Cu, Zn, and Mn, and 5% of Fe. Results show that metals would not be readily released to water under normal environmental conditions. However, if chelating agents were present, release of pollutants from sediments would occur. (Cassar-FRC)
W83-01661

A DECADE OF DEBATE: AIR AND WATER,
Ambio, Vol 11, No 4, p 216-220, 1982. 2 Fig, 5 Tab.

Descriptors: *Water quality, *Water supply, *Natural waters, *Oceans, Reviews, Research priorities, Environment, Environmental effects, Pesticides, Water pollution sources, Organic chemicals, Dumping.

Considerable advances were made during the past decade in scientific understanding of the physical and chemical properties of the world's oceans, and of the circulation of their waters. Coastal areas threatened by commercial development were given considerable attention. In studies of the open oceans, it appeared that serious contamination was localized, rather than ocean-wide. It is estimated that 25 billion metric tons of material are added to the oceans each year, more than 90% as runoff from rivers. About 6.4 million metric tons of persistent solid waste is dumped in the seas by ships. Pollution concentrations appear heaviest in coastal areas and landlocked seas, areas which yield over 90% of the world's marine fish catch. One particular detail may indicate the trend in marine resources during the coming years. At the Stockholm Conference a total ban on commercial whaling was one of the most widely-supported resolutions. Research also progressed during the 1970's on freshwater supplies. One hopeful sign was the reversal of the effects of eutrophication in several large lakes, including Lake Washington in the US and Lake Vattern in Sweden. (Baker-FRC)
W83-01668

HAZARDOUS WASTE LANDFILLS: SOME LESSONS FROM NEW JERSEY,
Princeton Univ., NJ. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5E.
W83-01670

PROCESSES AFFECTING THE MOVEMENT AND FATE OF TRACE ORGANICS IN THE SUBSURFACE ENVIRONMENT,
Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty, B. E. Rittmann, and M. Reinhard.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 93-117, 9 Fig, 4 Tab, 14 Ref.

Descriptors: *Organic compounds, *Sorption, *Adsorption, *Biodegradation, Pollutants, Groundwater pollution, Water pollution control, Subsurface water, Aquifers, Reclaimed water, Environmental effects.

Organic contaminants reach the subsurface environment when reclaimed waters are percolated through the soil surface or injected into aquifers either for groundwater replenishment or wastewater treatment. Two important phenomena relative to the movement and fate of these organic pollutants are adsorption and biodecomposition. Sorption affects the rate of travel of trace organics through subsurface systems relative to water, as well as the aquifer retention capacity for the organic. It appears that hydrophobic organic materials are sorbed (adsorbed or absorbed) by particulate organic material contained within or on the solid medium; therefore, the extent of sorption appears to be a function of the fraction of organic carbon in the subsurface matrix. At present, biodegradation appears to be the only significant process which can affect transformation of organic materials in the subsurface environment. Model studies have shown that there is a minimum concentration to which a single organic material can be decomposed under steady-state conditions. Trace organics are often below the minimum concentration. Biodegradation then generally occurs if they are used as secondary substrates, a condition requiring the presence of a primary organic substrate in a concentration higher than its minimum concentration, as well as the presence of a species of bacteria which is capable of decomposing both the primary and secondary substrate. Biodegradation can occur under different conditions as well. More studies are clearly needed. (Atkins-Omniplan)
W83-01700

FATE OF INORGANIC MICRO-CONTAMINANTS DURING GROUNDWATER RECHARGE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. C. Chang, and A. L. Page.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 118-136, 7 Tab, 28 Ref.

Descriptors: *Inorganic compounds, *Water quality, *Water quality standards, *Artificial recharge, *Pollutants, Soil absorption capacity, Soil profiles, Water treatment, Treated water, Wastewater composition, Wastewater pollution, Aquifers, Beneficial use, Minerals, Water properties.

This paper reviews the occurrence of inorganic micro-contaminants in treated wastewater effluents, their potential impact in terms of beneficial use of the water, and the capability of soils in attenuating contaminants in recharge water. The inorganic constituents of wastewater reflect the mineral composition of the source water; additional minerals may be picked up during use in urban areas. Trace elements in treated industrial effluents constitute most of the inorganic micro-contaminants in artificial groundwater recharge. In drinking water, the mineral content usually poses no health hazards but could be aesthetically unpleasant; for irrigation purposes, a high dissolved mineral content increases the soil's salinity. Depending on the physical characteristics of the water's impurities, the attenuation mechanisms vary. For constituents in suspended form, these include filtration, trapping and adsorption. Many micro-contaminants are present in recharged water in a dissolved state. A chemical rather than physical reaction is needed to immobilize the dissolved constituents, such as cation exchange, precipitation, surface adsorption, and chelation and complexation. Soils do not have unlimited capability in attenuating micro-contaminants, but they can retain large amounts of trace metal elements. However, long-term, continuous high rate applications of wastewater could cause substantial trace element enrichment of the surface soil, which may render the land unfit for subsequent agricultural development. For recharge systems, the composition of the specific wastewater effluent should be determined, and trace metal inputs for each case should be carefully evaluated. (Atkins-Omniplan)
W83-01702

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS-IV. INDICATORS OF HYDROCARBON POLLUTION FOR WATERS,
Tokyo Metropolitan Univ., (Japan), Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol 16, No 11, p 1521-1527, November 1982, 3 Tab, 47 Ref.

Descriptors: *Carbon, *Indicators, *Hydrocarbons, *Industrial wastes, *Comparison studies, *Urban areas, *Water pollution sources, *Rural areas, Organic compounds, Organic carbon, Aliphatic hydrocarbons, Water analysis, Fate of pollutants, Japan, Tokyo, Ogasawara Islands.

The ratios between organic carbons and hydrocarbon constituents (indicators of hydrocarbon pollution) were compared for polluted river waters from the Tokyo area and unpolluted waters from a river, brook, reservoir and pond of the Ogasawara Islands. The hydrocarbons as carbon (HCC)/total organic carbon (TOC), HCC/extractable organic carbon with ethyl acetate (EOC), squalane as carbon (SqC)/TOC, SqC/EOC, and unresolved complex mixture of hydrocarbons (UCMH)/n-alkane (C15-C33) ratios of the wastes from the Tokyo area were much higher than those of the waters from the Ogasawara Islands. Values of the carbon preference index (CPIH) for n-alkanes (C14-C34) close to unity were found in all water samples from the Tokyo area, and these were considerably lower than those of the unpolluted water samples from the Ogasawara Islands. These findings suggest that the HCC/TOC, HCC/EOC, UCMH/n-alkane and CPIH indices may be used as indicators of hydrocarbon pollution. The SqC/TOC and SqC/EOC ratios may also be useful indicators of urban or industrial effects on water systems. (Geiger-FRC)
W83-01710

TRACER MOVEMENT IN A SINGLE FISSURE IN GRANITIC ROCK: SOME EXPERIMENTAL RESULTS AND THEIR INTERPRETATION,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
I. Neretnieks, T. Ericksen, and P. Tahtinen.
Water Resources Research, Vol 18, no 4, p 849-858, August, 1982. 16 Fig, 4 Tab, 13 Ref.

Descriptors: *Tracers, *Sorption, *Radioactive wastes, *Granite, *Crystalline rocks, Radioactive tracers, Fate of pollutants, Groundwater movement, Fissure water, Cesium radioisotopes, Strontium radioisotopes, Lignosulfonates, Diffusion coefficient, Tritium, Dispersion, *Sweden.

Radionuclide migration in fissured crystalline granite was studied experimentally and with a model. This type of rock is considered most suitable for final disposal of nuclear plant wastes. A 30 cm long, 20 cm diameter long drill core with a natural fissure running parallel to the axis was surface coated with waterproof lacquer. One end of the core was injected with artificial groundwater containing various tracers, and effluent was collected for analysis at the other end. Tracers selected were tritiated water and lignosulfonate to characterize the water flow and Sr85 and Cs134 to simulate radioactive wastes. The breakthrough curves for the nonsorbing tracers (H+ and lignosulfonate) indicated that channeling occurred in the rock fissure. A dispersion model based on channeling was developed and used to prepare theoretical breakthrough curves for nonsorbing and strongly sorbing tracers. Substantial diffusion into and sorption in the rock matrix occurred, as well as sorption on the surface of the fissure. A combined model including the mechanisms of channeling, surface sorption, matrix diffusion, and matrix sorption was presented. Theoretical breakthrough curves obtained from this model were in fair agreement with experimental data, indicating that matrix diffusion may be an important factor in retarding radionuclides migration. (Cassar-FRC)
W83-01725

A MODEL FOR STREAMWATER CHEMISTRY AT BIRKENES, NORWAY,
Central Inst. for Industrial Research, Oslo (Norway).
N. Christophersen, H. M. Seip, and R. F. Wright.
Water Resources Research, Vol 18, No 4, p 977-996, August, 1982. 6 Fig, 5 Tab, 48 Ref.

Descriptors: *Acid rain, *Sulfates, *Streams, Acidic water, Fate of pollutants, Model studies, Water quality, Chemical reactions, Birkenes, *Norway, Forest watersheds, Hydrologic models, Aluminum, Calcium, Magnesium, Ion exchange, Weathering, Adsorption, Chemical precipitation, Mineralization, Gibbsite.

Major short-term variations in stream water chemistry during the snow free season were accounted for by a simple two-reservoir model using a small number of physically realistic processess. The site of the study was Birkenes, Norway, a 0.41 sq km gaged catchment in coniferous forest on granite bedrock. This area receives acid precipitation (weighted average pH, 4.24) and has acid stream water (pH 4.48). The model included hydrologic, sulfate, and cation submodels. Input requirements were precipitation volume and sulfate concentration, estimates of sulfur dry deposition, and daily mean temperature. Volume and concentration of major ions in stream water were simulated. The chemical processes included in the model were cation exchange, weathering, dissolution/precipitation of gibbsite, sulfate adsorption/desorption, and sulfate mineralization. Some stream water chemical characteristics simulated were: (1) elevated sulfate concentrations in the first autumn storm flow following a dry summer, with later decreases, (2) positive correlation between H+ and Al concentrations and discharge, and (3) negative correlations between factors in (2) with Ca and Mg concentrations. the weakest link is the hydrologic submodel, most evident for Ca and Mg results, which tended to fluctuate sharply. Al concentrations were generally underestimated. (Cassar-FRC)
W83-01733

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS, PORE WATER AND THE AMPHIPOD PONTOPOREIA HOYI FROM LAKE MICHIGAN,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie, P. F. Landrum, and W. Faust.
Chemosphere, Vol 11, No 9, p 847-858, September, 1982. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Sediments, *Invertebrates, Fate of pollutants, *Aromatic compounds, Pore water, Lakes, *Lake Michigan, Benthic fauna, Amphipods, Pontoporeia, Organic compounds, Bioaccumulation, Accumulation, Particle size, Organic matter, Hydrocarbons.

Concentrations of seven polycyclic aromatic hydrocarbons (PAH) were measured in Lake Michigan sediments, pore water, and in the amphipod Pontoporeia hoyi. Three different types of sediment were collected: coarse and low in organic carbon (0.4%) at 23 m depth; fine and higher in orgnic carbon (3.3%) at 60 m depth; and intermediate in particle size and organic carbon (1.7%) at 45 m depth. The fine sample contained the highest PAH levels in sediments: 4.6 ppm dry weight, with 0.18 ppm and 0.77 ppm in the coarse and intermediate samples, respectively. Approximate concentrations (in ng per g dry weight) of individual PAH in the fine sediments were: phenathrene, 700; anthracene, 200; fluoranthene, 1000; pyrene, 900; chrysene, 800; benzo(a)pyrene, 500; and benzo(ghi)pyrene, 350. Concentrations of individual PAH in the intermediate sediment ranged from about 17 to 250 ng per g dry weight and in the coarse sediment, from none detected to 65 ng per g dry weight. Pore water concentrations were similar among the 7 PAH, variable among the three stations, and did not appear to be strongly correlated with dissolved organic carbon. The Pontoporeia PAH concentrations were variable among the three sites. Patterns of PAH distribution in animals resembled that of their food source, the fine sediment. Fluoranthene and pyrene were most abundant and anthracene, least abundant. Bioconcentration factors were 10,000 to 100,000. Most of the phenanthracene, fluorene, and pyrene in the invertebrates were apparently derived from sediment and pore water, while chrysene and benzo(a)pyrene were obtained from water. (Cassar-FRC)
W83-01742

ENVIRONMENTAL ISSUES OF LIQUID TRANSPORTATION FUELS FROM COAL,
Oklahoma Univ., Norman.
M. A. Chartock, M. D. Devine, M. R. Cines, and S. E. Plotkin.
Environmental Conservation, Vol 9, No 2, p 131-139, Summer, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Environmental effects, *Coal liquefaction, *Industrial wastewater, Water pollution sources, Mine drainage, Coal mining, Air pollution, Acid mine drainage, Wastewater disposal, Zero discharge, Solid wastes, Leachates, Aquatic habitats, Water consumption, Trace metals, Metals, Hydrocarbons, Polyaromatic hydrocarbons, Phenols.

Coal liquefaction processes, either direct (hydrogenation) or indirect (conversion to CO and H2, followed by catalytic conversion to methyl alcohol or hydrocarbons), produce air emissions, water effluents, and solid wastes. Water may be polluted directly, by atmospheric fallout, and by leaching from solid wastes. Major sources of water pollution are coal feed (particulates, trace elements, and hydrocarbons), coal slurry preparation (gases and waste heat), the direct-process reactor (N and S compounds, heavy metals, H2S, ammonia, phenolics, and polynuclear aromatic hydrocarbons), and the gasifier (gases, oils, and phenols). The direct process releases more hazardous hydrocarbons and polynuclear aromatic hydrocarbons than the indirect process. Coal mining disrupts aquifers and pollutes streams with silt and acid drainage. Liquefaction plant wastewater streams contain phenol, ammonia, polynuclear aromatic hydrocarbons, chlorides, sulfates, cyanides, and trace elements such as As, Cd, and Hg. Leachates from solid

wastes, especially those produced in a reducing atmosphere, have low trace metals levels but significant polynuclear aromatic hydrocarbons levels. Aquatic ecosystems may be disrupted by use of large quantities of water and intermittent discharge of wastewater and by pollutants associated with mining. Plants located in the water-rich East would probably discharge wastes into already water quality-limited streams, whereas plants in the semiarid West would have water availability problems. (Cassar-FRC)
W83-01743

MULTICOMPONENT EQUILIBRIUM CHEMISTRY IN GROUNDWATER QUALITY MODELS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
A. A. Jennings, D. J. Kirkner, and T. L. Theis.
Water Resources Research, Vol 18, No 4, p 1089-1096, August, 1982. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Chelation, *Sorption, *Solute transport, Fate of pollutants, *Ligands, *Metals, Equilibrium, *Model studies, Groundwater movement, Finite element analysis.

A model for groundwater transport of a multicomponent solution of metals and ligands is decribed. It includes soluble complexation and competitive sorpiton among chemical species. A finite element solution is given for an arbitrary number of components. Although this technique produces strongly nonlinear equations, accurate solutions are still achieved. The interactions modeled significantly affect transport of solutes. This model has certain limitations. Multimetal complexes, multiligand complexes, and redox couples are omitted. The algorithm cannot treat redox potential or hydrogen ion concentration as dependent variables. It cannot handle phase exchange reactions which are not explicitly known or not differentiable. Precipitation and/or dissolution phase exchange are not included. However, the model has many potential applications. (Cassar-FRC)
W83-01747

OCCURRENCE OF ORGANOTIN COMPOUNDS IN ONTARIO LAKES AND RIVERS,
Canada Centre for Inland Waters, Burlington (Ontario).
R. J. Maguire, Y. K. Chau, G. A. Bengert, E. J. Hale, and P. T. S. Wong.
Environmental Science and Technology, Vol 16, No 10, p 698-702, October, 1982. 3 Tab, 33 Ref.

Descriptors: *Tin, *Industrial wastes, *Air-water interfaces, Fate of pollutants, *Ontario, Lakes, Rivers, Harbors, Ships, Water pollution sources, *Methyltin, *Butyltin, Toxicity, *Organotin compounds.

Butyltin, methyltin, and recoverable inorganic tin were determined at 28 sites in Canadian lakes, harbors, and rivers. In the unfiltered subsurface water concentrations (in micrograms per liter) were: butyltin ($Bu3Sn+$), 0.01-2.91; $BuSn(++)$, 0.01-7.30; $BuSn(3+)$, 0.02-8.48; total recoverable inorganic tin, 0.01-50-1; methyltin ($Me3Sn+$), 0.05; $Me2Sn(++)$, 0.02-0.40; and $MeSn(3+)$, 0.11-1.22. In the unfiltered surface microlayer concentrations (micrograms per liter) were: $Bu3Sn+$, 0.15-60.7; $Bu2Sn(++)$, 0.71-2600. $BuSn(3+)$, none detected; and total recoverable inorganic tin, 0.3-633. Highest concentrations of organotin compounds were in Kingston Harbor, Whitby Harbor, Collingwood Harbor, Lake St. Clair marina, Toronto Harbor, and Ramsey Lake. The highest levels were 60% of the 12 day LC100 value for sensitive aquatic species such as rainbow trout yolk sac fry. The sources of the tin compounds are chemical plants, ship traffic, atmospheric transport, and methylation of naturally-occurring tin. (Cassar-FRC)
W83-01748

5C. Effects Of Pollution

HYDROLOGY OF THE COAL-RESOURCE AREAS IN THE UPPER DRAINAGES OF HUNTINGTON AND COTTONWOOD CREEKS, CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
T. W. Danielson, M. D. ReMillard, and R. H. Fuller.
Geological Survey Open-file Report 81-539 (WRI), 1981. 85 p, 16 Fig, 2 Plates, 12 Tab, 29 Ref.

Descriptors: *Coal mines, *Surface water, *Mine drainage, *Water quality *Ground water, Springs, Aquifers, Water level, Recharge, Groundwater movement, Mine wastes, Deuterium, Benthic fauna, Chemical analysis, Hydrologic data, *Utah, Emery County.

This coal-resource area in the Upper drainages of Huntington and Cottonwood Creeks of central Utah was studied in order to better define the hydrologic system, to identify the hydrologic effects of underground coal mining, and to devise methods to detect these effects. Discharge records from gaging stations in this mountainous area indicated that there are large differences in the annual discharge of streams per unit area of drainage. These differences are attributed to differences in precipitation, differences in evaporation and sublimation of the snowpack, and to subsurface movement of water out of some basins, mainly along fractures. Dissolved-solids concentrations in surface waters ranged from 130 to 503 milligrams per liter; in ground water from about 140 springs dissolved solids ranged for 50 to 750 milligrams per liter. The Star Point Sandstone and the lower coal-bearing part of the Blackhawk Formation, both of Cretaceous age, are saturated in some areas, and the aquifer yields water to underground coal mines. Most of the larger springs in the study area discharge from the Star Point-Blackhawk aquifer where faulted. Ground water also occurs in several zones above the Star Point-Blackhawk aquifer. Possible impacts due to mine dewatering include the diminution of spring flows and increases tne ground-water recharge, both of which are more likely to occur where rocks have been fractured due to subsidence above mines. The discharge of mine waters into streams causes some degradation in surface-water quality. The year-to-year similarity of spring discharge recession curves may provide a method to detect unnatural changes in the ground-water system. Pollutants entering surface waters may be detected by changes in the population of benthic invertebrates. (USGS)
W83-01408

HYDROLOGIC CHARACTERISTICS AND POSSIBLE EFFECTS OF SURFACE MINING IN THE NORTHWESTERN PART OF WEST BRANCH ANTELOPE CREEK BASIN, MERCER COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4C.
W83-01409

OBSERVATIONS OF BEHAVIOURAL RESPONSES OF FISH TO ENVIRONMENTAL STRESS IN SITU,
Maryland Univ., Cambridge. Horn Point Environmental Lab.
C. H. Hocutt, R. F. Denoncourt, and J. R. Stauffer, Jr.
Journal of Applied Ecology, Vol 19, No 2, p 443-451, August, 1982. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Thermal stress, *Fish, Behavior, *Fish behavior, *Thermal discharge, Industrial wastes, Heated water, Powerplants, Adaptation, *Thermal pollution.

Three case histories which illustrate natural avoidance of fishes to stressful temperatures or oxygen regimes and two case histories which suggest that fish can adapt to artificially elevated water temperatures are presented. Such changes in thermal conditions could result from catastrophic events such as industrial spills or sudden elimination of a thermal discharge in winter. These case studies indicate that the recovery processes operating within a stressed ecosystem are dependent in part on natural avoidance behavior or acclimatization of organisms to otherwise unfavorable conditions. Adaptation to an altered environment can be achieved through either genetic or non-genetic means. (Baker-FRC)
W83-01410

BIOMASS OF HETEROTROPHIC AND AUTOTROPHIC ORGANISMS AS A FUNCTION OF MODE OF DISCHARGE (SURFACE OR SUBMERGED) OF SEWAGE IN THE BLACK SEA,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
E. A. Chepurnova, and L. C. Senichkina.
Hydrobiological Journal, Vol 17, No 4, p 27-31, 1981. 4 Fig, 6 Ref.

Descriptors: *Wastewater disposal, *Seawater, *Purification, Ocean disposal, Ecosystems, Phytoplankton, Algal growth, *Black Sea, Outfalls.

The relationship and the ratio between heterotrophs and photoautotrophs in marine waters variously polluted by domestic and municipal effluents discharged in either shallow or deep sites were examined. More vigorous growth of organisms was noted in sea zones of shallow (surface) and submerged discharge of biologically treated municipal sewage. This gives evidence of biological self-purification. The biomass of heterotrophic organisms is larger than that of autotrophic ones. While the number of organisms changes with distance from point of discharge, even at distances of 3 km away it is considerably larger than in water considered clean. Thus the change in the biomass-based ratio of heterotrophs to autotrophs describes the degree to which natural biological communities are disrupted by shallow and submerged discharge of effluents into the sea, and makes it possible to evaluate the ability of seawater to purify itself. (Baker-FRC)
W83-01414

ACCUMULATION OF DDT AS A FUNCTION OF LIPID CONTENT OF TISSUES OF FISH FROM ESTUARIES,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. V. Maslova.
Hydrobiological Journal, Vol 17, No 4, p 56-59, 1981. 1 Tab, 10 Ref.

Descriptors: *Estuaries, *Water pollution effects, *Fish, *DDT, *Lipids, Accumulation, Water quality, Environmental effects, Danube Delta, Dniepr-Bug Estuary.

The relationship between the DDT-residue content in the organs and tissues of fish and the lipid content of specific organs and tissues was examined. Samples of tissue and organ were taken from fish caught in the Kiliya Delta of the Danube and the Dniepr-Bug estuary for analysis for DDT Residues. The lipid content of organs and tissues of one- and five-year-old pike-perch and the bream proved higher in fish from the Danube than in those from the Dnieper-Bug estuary. DDT content was an order of magnitude smaller in the latter. It is assumed that the findings represent an adaptation of the fish to the polluted habitat. (Baker-FRC)
W83-01415

POLLUTION BY ARSENIC IN GOLD-MINING DISTRICT IN NOVA SCOTIA,
Massey Univ., Palmerston North (New Zealand). Dept. of Chemistry, Biochemistry and Biophysics.
R. R. Brooks, J. E. Fergusson, J. Holzbecher, D. E. Ryan, and H. F. Zhang.
Environmental Pollution, Series B, Vol 4, No 2, p 109-117, 1982. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Arsenic, *Mine drainage, Water pollution effects, *Stream pollution, *Sediments, Aquatic animals, Aquatic plants, *Path of pollutants, Mine wastes, Water pollution, Fate of pollutants, Water pollution sources, Metals, *Nova Scotia.

Arsenic (As) concentrations were measured in gold tailings, sediments, aquatic organisms and waters of a stream draining the Montague gold

mining district near Halifax, Nova Scotia. Background As levels were high in a brook upstream from the former mining activities but still remained below the safety levels of 50 nanograms/milliliter. During passage of the water through a non-polluted swamp, levels decreased, but went up again as the stream passed through the arseniferous gold tailings of the abandoned Montague Gold Mine. After this point, As levels decreased until they reached the outflow at Lake Charles. As levels in tailings were highest in downslope areas. In the Vicinity of the mine, As levels in stream sediments were high in clay and quartz fractions and remained so for the rest of the stream course. Levels of As in ashed twigs of alder growing along the stream and levels of As in aquatic organisms were well correlated with As levels in water. (Geiger-FRC)
W83-01417

EFFECT OF ADDED WATER AND ACIDITY OF SIMULATED RAIN ON GROWTH OF FIELD-GROWN RADISH,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
J. Troiano, L. Heller, and J. S. Jacobson.
Environmental Pollution, Series A, Vol 29, No 1, p 1-11, September, 1982. 1 Fig, 8 Tab, 11 Ref.

Descriptors: *Radishes, *Acid rain, *Plant growth, Water pollution effects, Root development, Biomass.

Radishes in field plots were subjected to simulated rain, acidified with sulfuric and nitric acids (2:1 by weight) to form solutions of pH 5.6, 4.2, 3.5, and 2.8. During the August 25-October 2 growing season 11 ambient rain events (8.72 cm) and 6 simulated rain events (4.90 cm) occurred. Although the acid rain treatments produced no visible changes in the plants, the fresh mass and the dry mass of the root were positively correlated with increases in acidity. Shoot mass was unaffected by pH, therefore root to shoot ratio increased with increasing acidity of rain. Plants receiving only ambient rain had the same total biomass but greater shoot mass and smaller root mass than plants receiving ambient rain plus rain at pH 5.6. (Cassar-FRC)
W83-01427

THE LOCH EIL PROJECT: BIOCHEMICAL COMPOSITION OF THE POLYCHAETE, GLYCERA ALBA (MULLER), FROM LOCH EIL,
Dunstaffnage Marine Research Lab., Oban (Scotland).
J. Blackstock, M. Barnes, and H. Barnes.
Journal of Experimental Marine Biology and Ecology, Vol 57, No 1, p 85-92, 1982. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Organic matter, *Pulp and paper industry, *Sediments, Glycera alba, Polychaetes, Invertebrates, Loch Eil, *Scotland, Water pollution effects, Estuaries, Carbohydrates, Anaerobic condition, Fjords.

Samples of Glycera alba (Muller), a predatory polychaete, were collected on six occasions, February 1976 to April 1977, in Loch Eil, Scotland. Concentrations of several components, expressed in mg per g fresh weight, were: carbohydrates, 2.0-5.1; lipid, 1.7-6.2; and protein, 60.0-78.0. Highest levels of carbohydrate and lipid were found in February 1976 and coincided with low inputs of pulp and paper mill effluents and high mean redox potential in the surface sediments. Minimum carbohydrate levels were found in December 1976 after a 2-month period of low redox potential values, a result of high inputs of organic wastes from the mill. The mean carbohydrate content of 3.4 + 1.0 mg per g fresh weight of G. alba tissue was consistent with the ability to utilize anaerobic metabolism during 2-3 days of anoxic conditions. (Cassar-FRC)
W83-01431

THE ENRICHMENT OF A MESOTROPHIC LAKE BY CARBON, PHOSPHORUS AND NITROGEN FROM THE CAGE AQUACULTURE OF RAINBOW TROUT, SALMO GAIRDNERI,
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak, W. Galicka, M. Molinski, E. Kusto, and M. Zalewski.
Journal of Applied Ecology, Vol 19, No 2, p 371-393, August, 1982. 15 Fig, 5 Tab, 37 Ref.

Descriptors: *Mesotrophic lakes, *Enrichment, *Nutrients, Nitrogen, Phosphorus, Carbon, Aquaculture, Lakes, Eutrophication, Trout, Fish, *Poland, Glebokie Lake.

The weights of bioelements (C, P, N) entering the mesotrophic Glebokie Lake during the production of 1 kg marketable trout were measured. The cage aquaculture of rainbow trout did enrich the lake with C, P, and N. Two generations were studied, from their introduction to the cages as 0 group trout in June until their removal as marketable trout in the Autumn of the following year. An inter-generation budget of energy and bioelements showed that for every kilogram of marketable trout produced, the lake was enriched by 0.75 kg C, 0.023 kg P, and 0.10 kg N (27.91), O.84, and 3.58 g/sq m/yr, respectively. This eutrophication is expected to cause the loss of the natural populations of Coregonidae. The harvesting of trout in summer and autumn prevented full use of the high levels of food during these periods. It is suggested that harvesting be done in October and November. (Baker-FRC)
W83-01434

WELFARE COST OF EUTROPHICATION-CAUSED PRODUCTION LOSSES: A CASE OF AQUACULTURE IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 6A.
W83-01435

A DESIGN FOR AQUATIC MONITORING PROGRAMS,
Battelle Pacific Northwest Labs. Richland, WA.
For primary bibliographic entry see Field 5G.
W83-01437

BIOASSAY OF THE TOXICITY OF NATURAL AND EFFLUENT WATERS USING CULTURES OF PROTOZOA,
All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 5A.
W83-01443

PHOSPHORUS LOADING TO A MOUNTAIN RESERVOIR IN SOUTHERN CALIFORNIA,
New York State Museum, Albany.
For primary bibliographic entry see Field 5B.
W83-01504

RELATIONSHIPS BETWEEN PHYTOPLANKTON GROWTH RATES AND NUTRIENT DYNAMICS IN LAKE NORMAN, N.C.,
Duke Power Co., Huntersville, NC.
M. S. Rodriguez.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119248, Price codes: A03 in paper copy, A01 in microfiche. Duke Power Technical Report Series DU-KEPWR/82-01, 1982. 39 p, 18 Fig, 2 Tab, 53 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Carbon, *Nitrogen, *Phosphorus, *Growth rates, Thermal stratification, Epilimnion, Hypolimnion, Photosynthesis, Dynamics, Fluctuations, Water temperature, Cycling nutrients, Nitrification, Nuclear powerplants, *North Carolina, Lake Norman.

A baseline study of phytoplankton production and nutrient dynamics was conducted on Lake Norman, NC, a 13,000 hectare, warm-monomictic reservoir, prior to the initiation of thermal inputs from an 1188-MW nuclear electric generation facility. The objective of the study was to identify the major physical, chemical and biological processes controlling nutrient dynamics in Lake Norman, with specific reference to the impact of phytoplankton production on the cycling of carbon, nitrogen and phosphorus. The results indicated that carbon fluxes on an annual basis were governed primarily by the biochemical processes of photosynthesis and respiration. Nitrogen dynamics also appeared to be biochemically controlled through photosynthesis, respiration, ammonification, nitrification and denitrification, although the physical adsorption of ammonia to the sediments was apparently an important factor in the hypolimnion. Very high particulate carbon-to-phosphorus ratios on the epilimnion indicated that the phytoplankton were severely phosphorus deficient and that phosphorus was rapidly cycled by the biotic community. In contrast, phosphorus dynamics during the isothermal period, and in the hypolimnion during the stratified period, were strongly influenced by the adsorption of phosphorus to inorganic materials such as clays suspended in the water column. Turnover times of carbon, nitrogen and phosphorus are quantified where possible, as are the fluxes of these nutrients to and from the atmosphere, epilimnion, hypolimnion and sediments.
W83-01526

MUTATION IN FERNS GROWING IN AN ENVIRONMENT CONTAMINATED WITH POLYCHLORINATED BIPHENYLS,
Massachusetts Univ., Amherst. Dept. of Botany.
E. J. Klekowski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150011, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, Amherst, Publication No 126, May 1982. 29 p, 2 Fig, 4 Tab, 32 Ref. OWRT A-129-MASS(1), 14-34-0001-0123.

Descriptors: *Polychlorinated biphenyls, *Water pollution effects, *Mutagens, *Flood plains, Housatonic River, *Massachusetts, *Ferns, Flooding, Arochlor 1254, Ostrich fern, Matteuccia struthiopteris, Connecticut River.

In Massachusetts, the Housatonic River is heavily contaminated, with polychlorinated biphenyls (PCB's), especially in the vicinity of the city of Pittsfield. General Electric in Pittsfield primarily used Arochlor 1254 in the production of transformers and utilized nearby municipal landfills for deposition of reject equipment and waste production materials. PCBs have been discharged into this ecosystem for more than 40 years. The ostrich fern, Matteuccia struthiopteris, forms extensive populations in the flood plain of the river, and favors sites annually inundated. The frequency of somatic mutations was determined in these fern populations as well as in control populations growing in uncontaminated environments in the Connecticut River and its tributaries. The frequency of somatic mutations in the Housatonic River populations was 5.21-6.17 times the controls. Assuming a causal relationship between the incidence of mutation in the Housatonic River ostrich fern populations and PCBs, the results suggest the possibility of plant activation of PCBs to mutagens. It is not known whether the ostrich fern is peculiar in its response to PCBs or whether it represents the general response of green plants to these compounds. (Moore-SRC)
W83-01529

GROWTH AND SURVIVAL OF CHANNEL CATFISH AND YELLOW PERCH EXPOSED TO LOWERED CONSTANT AND DIURNALLY FLUCTUATING DISSOLVED OXYGEN CONCENTRATIONS,
Environmental Research Lab., Duluth, MN.
A. R. Carlson, J. Blocher, and L. J. Herman.
Progressive Fish-Culturist, Vol 42, No 2, p 73-78, April, 1980. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Dissolved oxygen, *Catfish, *Perch, *Growth, Water quality, Fish, Mortality, Diurnal distribution, Fluctuations, Juvenile growth stage.

Information on dissolved oxygen (DO) levels and their fluctuation is important in establishing water quality criteria to protect the well-being of freshwater fish. Studies were undertaken to assess the effects of diurnal DO fluctuations on the growth

and survival of fish. Duplicate lots of juvenile channel catfish (Ictalurus punctatus) and yellow perch (Perca flavescens) were exposed for 69 and 67 days, respectively, to nearly constant DO levels of near air saturation (control) or DO levels of 6.5, 5.0, 3.5, and 2.0 milligrams/liter. The following year, juveniles of the same species were exposed to DO levels that fluctuated diurnally at about 1.5 milligrams/liter above and below the constant lower DO levels of the previous year. Growth of catfish was significantly reduced at mean DO levels of 3.5 milligrams/liter or less and at fluctuations of about 3.1 to 1.0 milligrams/liter. In perch, at mean constant DO concentrations near 3.5 milligrams/liter, less food was consumed, but growth was not affected, while at 2.0 milligrams/liter, less food was consumed and growth was significantly reduced. Fluctuations of about 3.8 to 1.4 milligrams/liter did not affect the growth of perch. Reduced DO exposures had no apparent affect on the survival rate of either species. (Geiger-FRC)
W83-01534

AN EMPIRICAL ANALYSIS OF PHOSPHORUS, NITROGEN, AND TURBIDITY EFFECTS ON RESERVOIR CHLOROPHYLL-A LEVELS,
W. W. Walker, Jr.
Canadian Water Resources Journal, Vol 7, No 1, p 88-107, 1982. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Water quality, *Reservoirs, Model studies, Nutrients, *Phosphorus, *Nitrogen, *Chlorophyll-a, *Turbidity, Algal growth, Transparency.

Relationships among chlorophyll-a, phosphorus, nitrogen, and transparency were empirically examined as part of an effort to assess the feasibility to applying empirical eutrophication models to reservoirs. The data base was derived from 480 water quality monitoring stations distributed throughout the United States. Existing models assume a direct relationship between seasonally averaged total phosphorus and chlorophyll-a concentrations. It is hard to identify sets of conditions under which chlorophyll is an exclusive function of total phosphorus in these reservoirs. The phosphorus/chl orophyll relationship derived from stations with average inorganic N/ortho-P ratios greater than 10 and non-algal turbidities less than .37/meter is found to be similar to phosphorus/chlorophyll relations derived from P-limited northern lakes. Nitrogen effects on chlorophyll-a are significant in about 22% of the station-years examined, and turbidity effects in about 69%. Modifications of existing empirical models to include nitrogen and turbidity as regulating factors are needed if they are to be valid and useful over the spectrum of physical and chemical environments found in reservoirs. (Baker-FRC)
W83-01551

THE APPLICATION OF PHOSPHORUS LOAD-TROPHIC RESPONSE RELATIONSHIPS TO RESERVOIRS,
Canadian Wildlife Service, Halifax (Nova Scotia).
For primary bibliographic entry see Field 2H.
W83-01552

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 6. SILVICULTURAL TREATMENTS,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
F. H. Everest, and R. D. Harr.
4 Ref.

Descriptors: *Forest management, *Anadromous fish, *Aquatic habitat, *Water quality, *Streamflow, *Water temperature, Soil erosion, Burning, Sediments, Runoff, Mass wasting, Solar radiation.

Distribution of anadromous salmonids and coniferous forest coincides along much of the Pacific Slope; consequently, the habitat of anadromous fish is subject to a wide variety of silvicultural treatments required to establish and nurture young forests. The silvicultural activities include: cutting prescriptions to improve natural regeneration; preparing sites for planting; removing slash to reduce fire hazard; seeding and planting; reducing competition to enhance growth of young trees. Anadromous salmonids have exacting habitat requirements and most production in forested watersheds occurs in small (first-order to third order) streams. Some silvicultural treatments, such as broadcast burning and machine scarification and piling, can degrade water quality and fish habitat in small streams, but seldom do so because of the low spatial and temporal intensity of the activities. The highest risk of habitat damage from silvicultural activities occurs in areas with erosive soils and high annual precipitation, or high summer solar radiation and low streamflow. Maximum risk from solar heating occurs in western and northeast Oregon, western and central Washington, northwest California, and central Idaho. High-risk areas for decreased water temperatures are located in northern and central Idaho, northeastern Oregon, southeastern Washington, northern British Columbia, and Alaska. Areas of central Idaho; northwest California; western Oregon, Washington, and British Columbia; and southeast Alaska are vulnerable to surface erosion and mass wasting. (Moore-SRC)
W83-01571

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 3. TIMBER HARVEST,
British Columbia Ministry of Environment, Victoria.
For primary bibliographic entry see Field 4C.
W83-01572

EFFECT OF SEWAGE EFFLUENT ON DRAGONFLIES (ODONATA) OF BULIMBA CREEK, BRISBANE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Entomology.
J. A. L. Watson, A. H. Arthington, and D. L. Conrick.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 517-528, 1982. 2 Fig, 6 Tab, 21 Ref.

Descriptors: *Bioindicators, *Dragonflies, *Stream pollution, *Outfall sewers, *Species diversity, *Population density, Larvae, Bioassay, Aquatic insects, Water quality, Water pollution effects, Outfalls, Toxicity, Species composition, *Australia, Bulimba Creek.

The use of the adult dragonfly (Odonata) as an indicator organism to detect stream pollution in Bulimba Creek, Brisbane, just downstream from the Mimosa Sewage Treatment Plant outfall was examined in field tests. Surveys at eight sample sites showed that the adult fauna is substantially restored farther downstream from the outfall, but the larval fauna and abundance are not. Of the 35 species of Odonata observed at Bulimba Creek, the 10 abundant stream-dwelling species were most affected by sewage effluent. Only one of these 10 species had adult members at the most contaminated site. Both adult and larval dragonfly fauna diversities gave a qualitative indication of water quality. Correlations between the distribution or abundance of Odonata and the concentrations of contaminants suggest that chlorine may be the major toxicant downstream of the Mimosa Sewage Treatment Plant outfall on Bulimba Creek. (Geiger-FRC)
W83-01581

APPLICABILITY OF PHOSPHORUS INPUT-OUTPUT MODELS FOR IMPOUNDMENTS WITH HIGH TROPHIC AND HYDRAULIC LOADING (ZUR FRAGE KRITISCHER NAHRSTOFFBELASTUNG GESTAUTER FLIESSGEWASSER. GRENZEN DER UBERTRAGBARKEIT DER FUR SEEN UND TALSPERREN KONZIPIERTEN MODELLE),
Ruhrverband, Essen (Germany, F.R.) Chemisches und Biologisches Lab.
E. A. Nusch.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 103-112, June, 1982, 14 Fig, 15 Ref.

Descriptors: *Phosphorus, *Chlorophyll, *Eutrophication, *Rivers, *Reservoirs, Model studies, Ruhr river, *Federal Republic of Germany, Kinetic models, Input-output models, Biomass, Algal growth, Phosphates, Radiation, Water Temperature, Light intensity, Nutrients, Retention time.

Models relating phosphorus (P) and chlorophyll to trophic state developed to aid in the restoration of lakes and reservoirs cannot be used for highly eutrophic impoundments of running waters, as has been shown by data collected in th Ruhr River reservoir system. Despite this, a relationship between P and chlorophyll exists in this region. Water storage time is less than plankton regeneration time until flow kilometer 70-100, when the first measurable concentrations of algae are apparent. P content is $>$ 400 microg/1 at flow kilometer 150 and rises to $>$ 800 microg/1 at the mouth, but the relatively high P concentration results in increased algal growth only after 3-4 days of flow. Data collected between 1965 and 1976 showed that P contents in the lower Ruhr approximately tripled in this period, that with high P concentration nitrogen also had a trophic effect, and that algal cell number and chlorophyll content more than doubled. Critical factors affecting mass algal development were low outflow, moderate or high water temperature, and moderate or high global radiation. Mass algal development was highest with extremely high phosphate contents and high light intensity. To reduce the risk of secondary pollution by algal biomass in the Ruhr, phosphate content should be $<$ 1.5 mg/1, corresponding to 500 microg/1 P04-P. However, threshold values for tolerable P load cannot yet be given for all impounded running water. Kinetic models based on the theory of continuous algal culture an on independent parameteers such as nurtient content, relationship between nutrients, light, temperature, and storage time, and those regard in the Ruhr system of reservoirs and the stretches of river between them as a single entity were more successful at describing the relationships between P, Chlorophyll, and trophic state than simple input-output models, which are based on completely mixed reactors. (Gish-FRC)
W83-01583

ACUTE TOXICITY OF CHROMIUM, MERCURY, MOLYBDENUM AND NICKEL TO THE AMPHIPOD ALLORCHESTES-COMPRESSA,
Australian Atomic Energy Commission Research Establishment, Sutherland.
M. Ahsanullah.
Australian Atomic Energy Commission Research Establishment, Sutherland.

Descriptors: *Heavy metals, *Mercury, *Toxicity, *Amphipods, Water quality management, Water pollution effects, *Chromium, *Molybdenum, *Nickel, Crustaceans, Water quality standards, Literature review, Allorchestes, *Australia, Western Port.

The acute toxic effects of chromium (Cr), mercury (Hg), molybdenum (Mo), and nickel (Ni) to the amphipod Allorchestes compressa were investigated in laboratory tests. The amphipods obtained from two localities in Western Port, Victoria, were exposed to the heavy metals via a continuously flowing seawater system. The 96-hr. median lethal concentration values for Hg, Cr, Ni, and Mo were 0.08, 5.56, 34.68 and 247.12 milligrams/liter, respectively. Since there is no information available on the application factor for Hg, the present results cannot be used to specify water-quality criteria. A minimal risk Hg concentration of 0.1 micrograms/liter has been set by the EPA. A brief review of literature which may help in establishing water quality criteria for heavy metals is presented. (Geiger-FRC)
W83-01589

INFLUENCE OF ADDED NUTRIENT ON THE SEASONAL VARIATION OF ALGAL GROWTH POTENTIAL OF MT BOLD RESERVOIR, SOUTH AUSTRALIA,
Adelaide Univ. (Australia), Dept. of Botany.
G. G. Ganf.

Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 475-490, 1982, 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Reservoirs, *Bioassay, *Essential nutrients, *Seasonal variation, *Algal growth, Nutrients, Eutrophication, Runoff, Catchment areas, Nutrient requirements, Cycling nutrients, Euphotic zone, Water temperature, Phytoplankton, Water quality control, *Australia, Mt. Bold Reservoir.

A series of bioassay experiments were conducted to assess the availability of major nutrients for phytoplankton growth in Mount Bold reservoir, South Australia. Major nutrient input occurred with the onset of winter rains, and growth potential increased from June to November within the euphotic zone. When the autumn overturn circulated nutrient-rich water from the hypolimnion, growth also increased. During periods of suspected nutrient depletion, routine enrichment experiments with phosphorus (P), nitrogen (N), and sodium-EDTA substantially increased the growth potential above that of the control. Only the combined addition of N and P caused a significant increase in growth potential during periods of nutrients depletion. Factorial nutrient-enrichment experiments to further investigate the effects of N and P on algal growth showed that nutrient enrichment during the higher temperature summer months is likely to cause significantly higher growth rates than enrichment during the cold winter months. (Geiger-FRC)
W83-01590

THE LOCH EIL PROJECT: THE BACTERIAL FLORA AND HETEROTROPHIC NITROGEN FIXATION IN SEDIMENTS OF LOCH EIL,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
D. Blake, J. W. Leftley, and C. M. Brown.
Journal of Experimental Marine Biology and Ecology, Vol 56, No 1, p 115-122, 1982. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrogen fixation, *Organic matter, *Pulp and paper industry, Sulfides, Bacteria, Sediments, Loch Eil, *Scotland, Water pollution effects, Sediments, Heterotrophic bacteria, Acetylene reduction, Sulfates, Estuaries, Fjords.

Acetylene reduction rates (nitrogen fixation) were higher in organic-rich Loch Eil, Scotland, sediments than in other nearby stations less affected by pulp and paper mill effluents. Large seasonal variations were observed. Counts of sulfate-reducing bacteria were 100 times higher than nitrate-reducing bacteria counts. Facultatively anaerobic nitrogen-fixing bacteria were not present in significant numbers. Sulfate-reducers were implicated in nitrogen-fixation, although there was no correlation between sulfate-reducing bacteria numbers and the fixation rate nor between sulfate-reducing bacteria numbers and sulfide concentrations. Nitrogen-fixation decreased with increases in sulfide concentrations, but no definite relationship could be ascertained. (Cassar-FRC)
W83-01593

THE INFLUENCE OF MODERN WATER SUPPLY AND WASTEWATER TREATMENT SYSTEMS ON WATER QUALITY IN MICRONESIA,
Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5F.
W83-01631

EFFECTS OF VEGETABLE OIL FACTORY EFFLUENT ON THE LEVELS OF PHOSPHATASES AND DEHYDROGENASES IN THE LIVER AND KIDNEY OF THE FRESHWATER TELEOST CHANNA PUNCTATUS (BL.),
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
P. K. Saxena, R. Bedi, and G. L. Soni.
Environmental Pollution, Series A: Ecological and Biological, Vol 28, No 4, p 245-253, August, 1982. 5 Tab, 24 Ref.

Descriptors: *Enzymes, *Fish, *Oil wastes, Water pollution effects, Phosphates, Dehydrogenases, Channa punctatus, Sublethal effects, Industrial wastewater.

The sublethal toxicity of vegetable oil factory effluent was evaluated by exposing fish (Channa punctatus) to a 25% concentration of effluent for up to 42 days. Activities of enzyme systems, expressed as a percentage of control, were: acid phosphatase, 45-65% in liver and 48-71% in kidney; alkaline phosphatase, 39-50% in liver and 42-67% in kidney; succinic dehydrogenase, 33-75% in liver and 47-38% in kidney; and lactate dehydrogenase, 38-79% in liver and 35-88% in kidney. The decline in phosphatase activities suggests a direct action of effluent on the enzyme system and impairment of lysosomal metabolism. The decrease in dehydrogenase activities indicates inhibition of aerobic and anaerobic metabolic pathways. (Cassar-FRC)
W83-01639

ENVIRONMENTAL CHANGE AND ITS IMPACT ON THE FRESHWATER FISHES OF IRAN,
Pahlavi Univ., Shiraz (Iran). Dept. of Biology.
For primary bibliographic entry see Field 4D.
W83-01660

A MODEL OF MERCURY CONTAMINATION IN A WOODLAND STREAM,
Michigan State Univ., East Lansing. Dept. of Electrical Engineering and Systems Science.
C. J. Herrick, E. D. Goodman, C. A. Guthrie, R. H. Blythe, and G. A. Hendrix.
Ecological Modelling, Vol 15, No 1, p 1-28, February, 1982. 8 Fig, 1 Tab, 61 Ref.

Descriptors: *Mercury, *Model studies, *Food chains, *Fish, *Streams, *Biological magnification, Water pollution effects, Heavy metals, Industrial wastes, *Detritus, Forest hydrology, Sediments, Aquatic populations, Invertebrates, Bioaccumulation.

A model was formulated for the prediction of mercury accumulation in a woodland stream. The model deals with four compartments - sediment, detritus, invertebrates and fish. Model inputs consist of concentrations of methyl and inorganic mercury in the water of the stream section. Detritus is described in terms of particle size and degree of microbial infestation. The model applies to a well-buffered hard water stream with a detritus-based food chain in which allochthonous production of organic matter dominates. Sediment type consists of fine to medium sand with a 1.0% organic content. The model predicts that methyl and inorganic mercury are significantly concentrated over levels in the water by each member of the food chain. It is suggested that current safe mercury levels in water should be reevaluated in order to keep mercury concentrations in fish below current action levels. (Geiger-FRC)
W83-01663

LAKE ROTORUA, THE STATE OF EUTROPHICATION,
B. Biggs.
Soil and Water, Vol 16, No 3, p 9-13, June, 1980. 3 Fig, 9 Ref.

Descriptors: *Lakes, *Eutrophication, *Water quality control, Water pollution control, Water quality, Nutrients, Phosphorus, Nitrogen, Wastewater disposal, Wastewater treatment, Lake Rotorua, *New Zealand.

The results of recent studies on the water quality of Lake Rotorua are presented and possible management options are considered. Lake Rotorua has exhibited all symptoms of eutrophication to varying degrees during recent years. Water transparency may be affected by the abundance of algae and detritus. The temperature of the lake water undergoes a marked seasonal change. Thermal stratification sometimes occurs in the lake for short periods during calm, hot summer conditions. Presently sewage effluent is discharged into the lake with 70% of the phosphorus removed. The degree of euthrophication of the lake will probably increase over the next 6-8 years if things continue without change, due to increases in population. Countereffects achieved through improved sewage treatment will not last much longer, as the system is already operating at near optimum efficiency. Possible advantages brought about through soil conservation measures are only projected, with not real knowledge available on the subject. (Baker-FRC)
W83-01688

A STUDY ON THE HEALTH ASPECTS OF GROUNDWATER RECHARGE IN SOUTHERN CALIFORNIA,
County Sanitation Districts of Los Angeles County, Whittier, CA.
W. E. Garrison, M. H. Nellor, and R. B. Baird.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 216-254, 13 Fig, 8 Tab, 23 Ref.

Descriptors: Water quality, *Groundwater recharge, *Water reuse, *Water quality criteria, *Water sampling, Monitoring, Testing procedures, Bacterial analysis, Population exposure, Reclaimed water, Chemical wastewater, Organic compounds, Viruses, Water Use.

The Orange and Los Angeles Counties Water Reuse Study was established to develop a long range water reuse plan for wastewater generated in the area, and included a Health Effects Study to evaluate the health aspects of reuse by groundwater recharge. The Montebello Forebay in L. A. County, as one of the oldest, best controlled potable reuse systems, was extensively researched. The study tasks included hydrogeologic studies to determine reclaimed water's influence on potable groundwater; water analyses for trace organics, trace metals, minerals and viruses; toxicologic studies to isolate health significant compounds; and epidemiologic assessments of the health impact on populations. The chemical, microbiological and toxicological characterizations of reclaimed waters and well waters require the interactive use of novel techniques and classical methodologies from several scientific disciplines, which are summarized herein. For instance, to assess health effects of recharge an estimate is needed of the percentage of reclaimed water in an exposed population's supplies. This involves use of a sulfate ion tracer model to measure the concentration of imported Colorado River water vs. native groundwater. One goal of the Health Effects Study was to develop a data base of health-suspect target organics, which are grouped as volatile and non-purgeable. Most of the volatile organics stem from industrial activities. Data generated by the Health Effects Study, to be completed in April 1982, can be used by California regulatory authorities as a basis for decision making regarding the fate of groundwater recharge as a viable reuse alternative and for developing recharge criteria. (Atkins-Omniplan)
W83-01709

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS-IV. INDICATORS OF HYDROCARBON POLLUTION FOR WATERS,
Tokyo Metropolitan Univ., (Japan), Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W83-01710

HEALTH EFFECTS OF DRINKING WATER DISINFECTANTS AND DISINFECTANT BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
R. J. Bull.
Environmental Science and Technology, Vol 16, No 10, p 554A-559A, October, 1982. 4 Tab, 41 Ref.

Descriptors: *Chlorination, *Disinfection, *Toxicity, Drinking water, *Reviews, Carcinogens, Mu-

tagens, Chlorine, Chlorine dioxide, Chloramines, Public health, Organic compounds, Chlorinated hydrocarbons, Trihalomethanes, Humix acids, Fulvic acids, Chloroform, Sublethal effects, Chlorophenols, Chloroacetonitriles, Organic matter.

This review of the toxicology of water disinfectants and their byproducts concerns present problems of acute and chronic toxicity and carcinogenic hazards and data gaps in these fields. Common disinfectants discussed are chlorine, chlorine dioxide, and chloramines. In spite of chlorine's long-term use in drinking water treatment there is little systematic toxicity data on this chemical, which exists in water as HOCl and OCl(-). HOCl appears to concentrate in bone marrow and to associate with cellular components, but the significance of this is not known. Upon oral administration chlorine dioxide is absorbed as chloride and chlorite and is excreted mostly as chloride with some chlorite. The chlorite ion is capable of producing methemoglobinemia, hemolytic anemia, depleted glutathione, and elevated 2,3-diphosphoglycerate. Chlorine dioxide appears to have antithyroid activity, the ability to increase cell turnover in the gastrointestinal tract, and the ability to depress spermatogenesis. Chloramines are associated with methemoglobinemia in dialysis patients and with mutagenesis. Oxidation and chlorination byproducts of disinfectants include trihalomethanes such as chloroform, a known carcinogen. Other trihalomethanes, under study in a carcinogenic bioassay program, show liver toxicity at very high doses but not at levels associated with drinking water. Other byproducts, some carcinogenic or mutagenic, are chlorinated phenols, haloacetonitriles, organic N-chloramines, and humic and fulvic acid chlorination products. Many byproducts have not yet been chemically characterized. Today's available information, although insufficient in many respects, does not mandate replacement of the commonly used disinfectants at the present time. Research should be directed toward filling the gaps in toxicity data, especially the low-level chronic types, and determining reaction conditions (pH, etc.) most suitable for minimizing harmful byproducts during the water treatment process. (Cassar-FRC)
W83-01740

5D. Waste Treatment Processes

ANAEROBIC DIGESTION OF DISTILLERY EFFLUENTS,
Agriculture and Forestry Univ., Vienna (Austria). Dept. of Applied Microbiology.
R. Braun, and S. Huss.
Process Biochemistry, Vol 17, No 4, p 25-27, July/August, 1982. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Anaerobic digestion, Industrial wastewater, *Food-processing wastes, Fermentation, Potatoes, Molasses, Corn, *Anaerobic filtration, *Wastewater treatment, Plug flow, Digestion, Suspended solids.

Beet molasses distillery slops (COD 45-50 g O2 per liter) were treated by anaerobic filtration at a mean residence time of 1.2 days and volumetric loadings up to 38 kg volatile solids per cu m per day with a maximum biogas production of 14.2 cu m per cu m per day (or 0.37 cu m per kg volatile solids) and 50% degradation of COD. Biogas methane content varied from 75% at 2 kg volatile solids per cu m per day to 61% at the highest volumetric loading. Maize and potato slops, unsuitable for filter treatment, were treated in a plug flow reactor inclined at 10-15 degrees. For maize and potato slops, respectively, residence times were 13 and 10 days; COD degradation, 40-50%; maximum gas production, 1.9 and 0.8 cu m per day. Although the anaerobic filtration process was suitable for treating molasses slops, it was not applicable to effluents with high insoluble solids content. (Cassar-FRC)
W83-01419

USE OF UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR TO TREAT ACETATE RICH WASTE,
Birmingham Univ. (England). Dept. of Chemical Engineering.
S. J. Godwin, D. A. J. Wase, and C. F. Forster,.
Process Biochemistry, Vol 17, No 4, p 33-34, 45, July/August, 1982. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Industrial wastewater, *Anaerobic digestion, Acetic acid, *Wastewater treatment, Digestion, Anaerobic filters, Upflow Sludge blanket reactor.

An upflow anaerobic sludge blanket reactor effectively treated industrial wastewater containing 1 gram per liter acetic acid and traces of acetone, ethyl acetate, benzene, hemicelluloses, salts, and corrosion products. COD of up to 1000 mg per liter was reduced by 70% at a hydraulic retention time of 9.8 hours. Gas production (up to 99% methane) was optional at an organic loading rate of 1.6 kg BOD per cu m per day. pH was increased about 1 unit during treatment. The system was self-scrubbing, removing CO2 as sodium carbonate. (Cassar-FRC).
W83-01420

IDENTIFICATION AND CONTROL OF INHIBITION IN THE ANAEROBIC TREATMENT OF INDUSTRIAL WASTEWATERS,
Newcastle-upon-Tyne Univ. (England). Public Health Engineering Div.
G. K. Anderson, T. Donnelly, and K. J. McKeown.
Process Biochemistry, Vol 17, No 4, p 28-32, 41 July/August, 1982. 5 Fig, 1 Tab, 23 Ref.

Descriptors: *Anaerobic digestion, Industrial wastewaters, *Methanogenesis, *Inhibition, Digestion, Hydrogen sulfide, Volatile acids, Sulfates, Bacteria, Heavy metals, Metals, Ammonia, *Wastewater treatment.

Hydrogen sulfide inhibition of methanogenesis in the anaerobic digestion of industrial wastewaters has been prevented by using a stable anaerobic microbial association which maximizes the yield of methane in the presence of sulfate. In a molasses distillery effluent with 7500 mg per liter sulfate and 62,000 mg per liter COD the methane yield was increased by 0.1 cu m per kg COD applied using the microbial association, compared to an initial 0.234-0.261 cu m per kg COD applied. The technique prevents formation of hydrogen sulfide in sulfate-rich wastewaters and eliminated the need for sulfide-stripping equipment. Methanogenesis inhibition by pH outside the range 6.6-8.0, volatile acids concentrations above 500 mg per liter, heavy metals, or ammonia may be controlled by neutralization, precipitation, or other simple techniques. Acclimatization and antagonism can also increase the threshold level for inhibition. The most sensitive indications of inhibition are drop in methane yield and high volatile acids concentrations. (Cassar-FRC).
W83-01421

USE OF OZONE IN A WATER REUSE SYSTEM FOR SALMONIDS,
Bureau of Sport Fisheries and Wildlife, Cortland, NY. Tunison Lab. of Fish Nutrition.
R. C. Williams, S. G. Hughes, and G. L. Rumsey.
Progressive Fish-Culturist, Vol 44, No 2, p 102-105, April, 1982. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Aquaculture, *Water reuse, *Ozone, Fish, *Wastewater treatment, Biofilters, Trout, Dissolved oxygen, Oxygen, Filters, Aeration.

Ozone and biological filters were used to treat water for reuse in a pilot-scale salmonid rearing system. Components of the system included rearing units, sludge settler, sand biofilter, charcoal biofilter, ozone contactor with froth removal, and head trough. Water flowed through a plexiglass ozone contactor consisting of four chambers. Air-ozone mixtures were bubbled through at 13 liters per min and a pressure of 2.33 kg per sq cm. Residual ozone was dissipated in a cascade between the contactor and collecting head trough. Dissolved oxygen concentrations were about 8 mg per liter at the head trough and as low as 2 mg per liter leaving the charcoal biofilter. Residual ozone in the rearing units was 0.02 mg per liter. Fingerling trout grown for 8 weeks using the ozone purification system had significantly higher growth rates and feed:gain ratios than fish reared in a single-pass system. (Cassar-FRC)
W83-01423

REUSE AND DISPOSAL CONSIDERATIONS FOR HYPERFILTRATION CONCENTRATE,
Clemson Univ., SC.
J. L. Gaddis, D. A. Jernigan, H. G. Spencer, and C. A. Brandon.
Resources and Conservation, Vol 9, p 259-270, 1982. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Membrane processes, *Wastewater renovation, *Dye industry wastes, Wastewater treatment, Industrial wastewater, Water reuse, Hyperfiltration, Textile mill wastes, Sludge disposal, Zero discharge, Filtration.

Reuse of hot hyperfiltration-renovated wastewater from a continuous dye range was studied. Effluent from the dye bath contained about 15% residual dye of several classes, thickener, and solvents. Performance of the zirconium oxide-polyacrylic acid membranes was evaluated under field conditions during 720 hours of runs over a 6-week period. Recoveries were 0-96%; velocities, 2-6 m per sec; pressures, 1.29-9 .02 MPa; and temperature, 85C. Color rejection remained near 99% for the duration of the test, with lower values occurring for some basic/direct dye mixtures used on acrylic fabric. Permeate samples, evaluated for reuse as wash water, showed color rejections of the accepted 0.97 or better in 23 of 24 samples and acceptable staining indexes of < 1.1 in 18 of 24 samples. Tests for reuse of the concentrated dye wastes showed that average dye reduction was 23% for direct dyes and less for other dye classes; overall average was 19% reduction. Unusable dye concentrate was dried to a granular solid. This solid and the ash produced upon incineration of the solid contained levels of metals and pesticides within allowable limits for disposal to landfills. (Cassar-FRC)
W83-01501

AN INVESTIGATION OF FOREIGN BY-PR ODUCT COKE PLANT AND BLAST FURNACE WASTEWATER CONTROL TECHNOLOGY AND REGULATION,
Hydrotechnic Corp., New York.
H. Hofstein, and H. J. Kohlmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-221771, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-245, July 1982. Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina. 5 p, 1 Tab.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Steel industry, *By-product coke plant wastes, *Blast furnace wastes, *Regulations, *Wastewater treatment, Water pollution control, Aeration, Filtration, Cyanide, Water reuse.

An engineering study of 25 steel plants in 14 countries was carried out to determine if more effective wastewater control technologies for by-product coke plant and blast furnace gas cleaning wastewaters are being used in foreign plants than in domestic ones. Some unusual techniques for the treatment of blast furnace gas cleaning wastewaters were found. Aeration of the wastewater prior to clarification improved settling and allowed a greater rate of recirculation. Filtering the wastewater through slag or flue dust removed cyanide. Treatment of by-product coke plant and blast furnace gas cleaning wastewater is, in general, not more advanced in foreign plants than in the U. S. However, blast furnace gas cleaning water in foreign plants is generally recycled to a greater degree. Also, highly qualified and experienced wastewater treatment plant operators and high level plant management involvement were frequently observed at foreign plants. A noticeable spirit of cooperation between regulators and industry was observed in many countries. Discussions were held with plant and corporate personnel at 26 plants in 14 countries and with regulatory agencies

in 10 of the 14 countries to determine the regulations imposed upon the plants, the incentives provided to reduce pollution loads to receiving waters, and to investigate treatment technology. (Moore-SRC)
W83-01559

AUTOHEATED, AEROBIC THERMOPHILIC DIGESTION WITH AIR AERATION,
Cornell Univ., Ithaca, NY.
W. J. Jewell, R. M. Kabrick, and J. A. Spada.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-196908, Price codes: A16 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-82-023, May 1982. Municipal Environmental Research Laboratory, Cincinnati, Ohio. 5 p.

Descriptors: *Sludge digestion, *Disinfection, *Biodegradation, *Heavy metals, *Autoheating, *Aeration, Computer models, Sludge drying, Pasteurization, Bacteria, Viruses, Parasites, Thermophilic bacteria, Dissolved oxygen, Temperature.

This 2-year study developed a new sludge treatment process capable of rapid stabilization, pasteurization, and heavy metal removals from dilute sewage sludge. A full-scale system demonstrated that simple self-aspirating aerators that used ambient air could achieve high oxygen transfer efficiencies and thereby allow conservation of the heat of oxidation to achieve autoheating to high temperatures. The relationship between process variables and the autoheating phenomena were examined at full-scale and bench-scale levels. Intermediate loading rates and low dissolved oxygen residuals allowed maximum temperature development. Two different aerators were tested and were found to achieve oxygen transfer efficiencies exceeding 20% at reactor temperatures that often exceeded 60C. Operational problems associated with these aerators as well as with the other equipment on the thermophilic digestion facility were identified and examined. Virus inactivation was 100% in most cases, with bacterial and parasite indicator counts less than those found in the effluent from the full-scale, mesophilic anaerobic digester. The dewaterability of the autoheated, thermophilic digester effluent deteriorated at all loading conditions studied. The aerobic, thermophilic-digestion process appears to increase the solubility of various heavy metals such as cadmium. A computer model was developed from the full-scale data for predicting the reactor temperature under given loading conditions. (Moore-SRC)
W83-01560

FULL-SCALE DEMONSTRATION OF INDUSTRIAL WASTEWATER TREATMENT UTILIZING DU PONT'S PACT PROCESS,
Du Pont de Nemours (E. I.) and Co., Inc., Deepwater, NJ.
H. W. Heath, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-248122, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-159, December 1981. Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma. 9 p, 1 Fig, 6 Tab.

Descriptors: *Wastewater treatment, *Activated carbon, *Aeration, *Cost analysis, *Industrial wastewater, Secondary wastewater treatment, Tertiary wastewater treatment, Biological treatment, Activated sludge process, Hazardous materials.

Operating and cost data on startup and the initial 30 months of operation of a 150,000 cu m/day (40-MGD) industrial wastewater treatment plant using Du Pont's PACT process are reported. The PACT process effectively provides both secondary and tertiary treatment by adding powdered activated carbon to the aerator in an activated sludge process. In 1978 and 1979, performance exceeded expectations in terms of BOD5 and color removal, 96% and 68%, respectively. Removal of Dissolved Organic Carbon (DOC) was 82%, approximately equal to the design value. Removals were consistent even through the medium-strength waste contained many relatively toxic, non-biodegradable organics and varied drastically in composition. EPA designated hazardous substances in the waste were removed very well. A synergistic enhancement of biological activity in the presence of activated carbon was observed. Operation at over 25 days sludge age reduced the required carbon dose from more than 170 mg/liter to 120 mg/liter. Activated carbon was regenerated from wasted PACT sludge in a multiple-hearth furnace. Carbon was regenerated at 80% yield with recovery of 63% of virgin carbon properties. Production rate and quality recovery were below expectations. Furnace performance was hurt by underdesigned filtration and solids conveying equipment which limited throughput and in-time. Excluding depreciation, operating costs were equal to projections, and for secondary/tertiary treatment alone have averaged $0.16/cu m ($0.61/1,000 gal.). Including depreciation, costs have averaged $0.22/cu m ($0.82/1,000 gal.).
W83-01562

INFILTRATION LAND TREATMENT OF STABILIZATION POND EFFLUENT,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
J. N. Dornbush.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109919, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency, Project Summary EPA-600/S2-81-226, December 1981. Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma. 5 p, 3 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Land disposal, *Rapid infiltration, *Freezing, South Dakota, Stabilization ponds, Effluents, Biochemical oxygen demand, Suspended solids, Phosphorus, Nitrogen compounds.

Stabilization ponds are the predominant type of treatment employed by municipalities of 5,000 persons or less in the Upper Great Plains Region. However, the ability of these ponds to meet present and future effluent standards is limited. A rapid infiltration system, designed and operated to make the maximum use of an available in-place soil, is considered as a potentially economical solution to meet future effluent requirements of stabilization ponds. A rapid infiltration pilot wastewater treatment system consisting of three 0.07 hectare basins was operated for four seasons at Brookings, South Dakota. The objectives of the study were to demonstrate that rapid infiltration land treatment could upgrade stabilization pond effluent to meet stringent effluent requirements and to identify winter operating constraints for the system. After passing through 1.3 m of the soil profile, the following quality was observed: BOD5 was less than 4 mg/l all of the time and generally less than 2 mg/l; the suspended solids rarely exceeded 4 mg/l; total phosphorus rarely exceeded 1 mg/l; ammoniacal nitrogen was less than 2 mg/l and usually less than 1.1 mg/l; and nitrate nitrogen rarely exceeded 10 mg/l. Winter operation of the pilot units with intermitten t applications was not practical. Ice accumulated with each successive flooding and operation had to be discontinued in early January. The entire period when wastewater was not applied during one winter was less than three months long. Existing stabilization ponds in South Dakota which are frequently designed with six months of detention could probably be operated to provide both the preapplication treatment and the necessary emergency storage capacity to carry through the most severe winters. (Moore-SRC)
W83-01570

ORGANIC SOLVENT REGENERATION OF GRANULAR ACTIVATED CARBON,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
W. H. Cross, M. T. Suidan, M. A. Rollor, B. R. Kim, and J. P. Gould.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150201, Price codes: A13 in paper copy, A01 in microfiche. Georgia Institute of Technology Environmental Resources Center Report ERC 08-82, September 1982. 279 p, 105 Fig, 31 Tab, 66 Ref, 6 Append. OWRT B-141-GA(1).

Descriptors: *Activated carbon, *Regeneration, *Cost analysis, *Organic solvents, *Wastewater treatment, Adsorbents, Industrial wastewater, Economic feasibility, Pore size.

Although the use of activated carbon for the treatment of industrial waste-streams has been shown, in many cases, to be an effective treatment alternative, the high costs associated with the replacement or thermal regeneration of the carbon have prohibited the economic feasibility of this process. The in situ solvent regeneration of activated carbon by means of organic solvent extraction has been suggested as an economically attractive alternative to thermal regeneration. Four adsorbates of varying molecular weights and sizes were employed along with 5 commercially available activated carbons in a series of continuous flow column studies in order to evaluate the effects of molecular size, regeneration temperature, solvent type and activated carbon characteristics on regeneration efficiency. In addition, the reuse of non-recovered (contaminated) solvent and the corresponding effect upon the economic feasibility of the regeneration process were examined. It was concluded that the important aspects of the solvent regeneration process include: the physical and chemical characteristics of the adsorbent, particularly the pore size distribution and energy of adsorption associated with the activated carbon; the degree of solubility of the adsorbate in the organic solvent; the miscibility of the organic solvent in water; and the temperature at which the generation is performed. The economic feasibility of the process was determined to be directly related to costs incurred for energy requirements and to the recoverability of valuable adsorbates for subsequent reuse in the industrial process. (Moore-SRC)
W83-01613

UPGRADING A LARGE TREATMENT PLANT--PROBLEMS AND SOLUTIONS,
Sanitation Districts of Los Angeles County, Whittier, CA.
M. Moshiri, R. R. Luthy, Jr., and B. E. Hansen.
Journal of the Water Pollution Control Federation, Vol 54, No 9, p 1270-1280, September, 1982. 8 Fig, 4 Ref.

Descriptors: *Pilot plants, *Construction, *Design criteria, *Wastewater treatment, Los Angeles, *California, Polymers, Field tests, Dewatering, Screens, Sludge, Primary wastewater treatment.

In the last decade some additions to the Los Angeles County Joint Water Pollution Control Plant at Carson, California, had significant start up problems. These projects, primarily those involving new technologies, were a system for adding anionic polymer to the primary sedimentation tanks, a system for treating flows generated from digester cleaning, an upgraded solids dewatering facility, and a primary effluent screening system. Start-up problems traceable to pilot testing and design were unanticipated changes in characteristics or flow of the waste stream and/or scale-up problems. Unanticipated changes were illustrated by the dewatering system in which solids concentrations of the feed changed from 4.25% to < 3.0% and particle size decreased between pilot studies and full-scale operation. These serious dificulties were solved by operating the centrifuges in parallel instead of series. In the effluent screens projet, pilot testing did not anticipate the extreme fiber buildup and occasional solids carry over that occurred on start-up. Replacement of stainless steel mesh with polyester screen fabric and straining the screen spraying water (screened effluent) helped improve these malfunctions. Scale-up problems fell into two classifications: process failures and supporting system failures. In the Joint Water Pollution Control Plant sludge storage silos, designed to use sludge as a 'live bottom', failed to hold the sludge. Shutoff gates were installed in each silo. Examples of failure in supporting systems were frequent malfunctions of the polymer wetting devices and problems with solids conveying systems. The importance of hiring readily-trainable personnel, comprehensive

training programs, and a low turnover rate for operators was emphasized. (Cassar-FRC)
W83-01638

OXIDATION-STABILIZATION KEEPS SLUDGE FARM HEALTHY.
American City and County, Vol 97, No 9, p 75-77, September, 1982.

Descriptors: *Sludge disposal, *Oxidation, *Stabilization, *Wastewater treatment, Sludge treatment, Sludge, *Pennsylvania, Financial aspects, Anaerobic digestion, Advanced wastewater treatment.

The Municipal Sewer and Water Authority of Cranberry Township in Pennsylvania expanded its treatment works to 3.0 MGD. This expansion required a method of sludge treatment that would be compatible with the Authority's disposal method, yet flexible enough to handle the facility's growing capacity requirements. The BIF process was selected partly because of its low intial cost, and because of its apparently low operating and maintenance costs. About $1000 a month is spent on polymers for dewatering and chlorine, and the average cost of deactivation and dewatering is about $16 a ton. In addition to the economic considerations, the chemical oxidation process provided other important benefits, primarily that all potentially pathogenic organisms in the sludge were burned off, and also that the sludge treatment was completed in a matter of hours compared to 30 to 40 days, which would be typical of an anaerobic digester. Cranberry Township's sludge oxidation system processes about 3,500 to 3,800 lb of sludge per day, operating four or five hours a day, five days a week. Truckloads of dewatered sludge are sent to a farm for spreading three or four days a week. While the ryegrass, soybeans, wheat and shell corn grown on the farm are used only for animal feed, testing of the soil continues to make sure that the sludge does not introduce an undue amount heavy metals. The stabilized sludge acts as a soil conditioner, keeping the soil loose and reducing some of the need for fertilizer on Brush Creek's farm. (Baker-FRC)
W83-01640

KINETICS OF BIODEGRADATION OF 2,4-DICHLORO-PHENOXYACETATE IN THE PRESENCE OF GLUCOSE,
Minnesota Univ., Minneapolis. Dept. of Chemical Engineering.
A. C. Papanastasiou, and W. J. Maier.
Biotechnology and Bioengineering, Vol 24, No 9, p 2001-2011, September, 1982. 7 Fig, 12 Ref.

Descriptors: *Herbicides, *Inhibition, *Biodegradation, *Wastewater treatment, Glucose, Organic compounds, Acclimation, Kinetics, Biomass, Degradation, Organochlorine compounds, *2,4-D.

Biodegradation of 2,4-dichlorophenoxyacetate (2,4-D) and glucose were studied in batch tests using a biomass acclimated to 2,4-D. Glucose alone was degraded by the acclimated biomass after an initial lag phase of 20 hours. Data fit typical Monod kinetics. Digestion for an 85 mg per liter glucose solution was almost complete within 50 hours. 2,4-D alone followed Andrews' substrate inhibition model. Within 120 hours a 2,4-D solution of initial concentration of 95 mg per liter was reduced to about 10 mg per liter. For a glucose-2,4-D mixture, mutual inhibition was observed. However, the inhibition effects were generally not a linear function of the inhibiting substrate. The presence of the second substrate caused formation of additional active cell mass which in turn increased the rate of target substrate utilization and decreased mean cell residence time. This extends the area of process stability to higher dilution rates and higher influent concentrations. (Cassar-FRC)
W83-01643

DISTRIBUTION AND BEHAVIOR OF SLUDGE IN UPFLOW REACTORS FOR ANEROBIC TREATMENT OF WASTEWATER,
Shell Internationale Petroleum Maatschappij, The Hague (Netherlands).
C. Buijs, P. M. Heertjes, and R. R. Van der Meer.
Biotechnology and Bioengineering, Vol 24, No 9, p 1975-1989, September, 1982. 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, Model studies, Sludge, *Upflow reactors.

A model was developed to describe the physical behavior of the sludge blanket in an aerobic upflow reactor. Based on the mass balance for the sludge in the blanket, the model predicts the distribution of sludge in an upflow reactor in relation to the gas production, sludge settling characteristics, and the linear fluid velocity in the reactor. The values of the transport factors for sludge particles transported by gas bubbles from the bed to the blanket were similar for the 30 cu m pilot plant and the 200 cu m full scale reactor. The model is suitable for predictions in reactors treating wastewater containing lower fatty acids as the main organic pollutants. It can be used for bed-blanket systems and bed-transition area-blanket systems. However, a gradient in the sludge concentration present in the transition area cannot be predicted. (Cassar-FRC)
W83-01644

WEIGHING THE WASTEWATER OPTIONS,
B. A. Leibowitz.
BioCycle, Vol 23, No 4, p 47-49, July/August, 1982. 1 Fig.

Descriptors: *Wastewater treatment, *Economic aspects, *Wastewater disposal, Sludge disposal, Disposal, Suburban areas, Septic wastewater.

In the last several years increasing cost factors have necessitated a shift toward relatively low cost innovative/alternative technologies for reliable, cost-effective suburban and small community wastewater treatment. Eight alternative wastewater management plans were studied, ranging in average annual cost to the homeowner from $277 to $914. These eight included: conventional gravity sewers to the regional treatment plant; low-pressure sewers with gravity sewers to regional plant; local treatment plants with gravity sewers; holding tanks to replace all irreparable on-site septic systems, with repair and continued use of reparable systems; community subsurface disposal systems with limited partial sewering of irreparable septic systems and continued use of reparable systems; partial gravity sewering to local treatment plants for irreparable septic systems and continued use of reparable systems; and partial sewering of irreparable systems with regional treatment. Based on various considerations, the last alternative was recommended as the most readily implementable, surest to gain public acceptance, and lowest in cost. It is noted that communities, particularly suburban and small communities, must take a broad view during the wastewater facility planning process and consider the various engineering options open and available. (Baker-FRC)
W83-01658

WATER HYACINTH - AN APPROPRIATE SOLUTION TO WATER POLLUTION PROBLEMS,
Delhi Coll. of Engineering (India).
R. Mehrotra, and A. F. S. A. Aowal.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 62, No 2, p 43-46, February, 1982. 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Water hyacinths, Methane, Digestion, Aquatic plants, Water pollution control, Economic aspects.

A brief review is offered of the work already completed at various laboratories throughout the world in connection with the use of the water hyacinth as a decontaminating device. It is noted that this plant can work as a treatment media for treating wastewater with a wide array of characteristics. The importance of the water hyacinth is also stressed from the viewpoint of the treatment efficiency with respect to the various pollution parameters and the economic aspects of such a system. A combination of conventional water treatment technology and controlled growth of higher plants can produce cost effective, advanced wastewater treatment systems in warm and moderate climates. Plant material harvested from this type of system can be further processed into usable products such as compost. Anaerobic digestion of this harvested biomass produced 0.18 cubic meters of methane/kg dry plant in about 24 days digestion period. (Baker-FRC)
W83-01682

DRAINAGE SYSTEMS FOR LAND TREATMENT OF WASTEWATER,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, and A. Nassehzadeh-Rabrizi.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR3, p 196-211, September, 1982. 11 Fig, 3 Tab, 9 Ref.

Descriptors: *Wastewater disposal, *Land application, *Drainage systems, Wastewater treatment, Land disposal, Subsurface drainage, Model studies, DRAINMOD, Wilmington, *North Carolina, Water table, Infiltration.

The water management model, DRAINMOD, was used to design and evaluate drainage systems for land treatment of wastewater. DRAINMOD simulates the performance of a given drainage system design and wastewater application strategy for several years of climatological record. It can identify sequences of weather events which severely test the system or cause delays in scheduled wastewater application. Several designs and application strategies were evaluated on a poorly drained sandy loam soil near Wilmington, North Carolina, to determine their effects on the amount of wastewater that could be treated, changes in volume with weather conditions, water table depth outflow volumes, and required wastewater storage. On this poorly drained site the amount of wastewater applied was significantly increased by using subsurface drainage. A drain spacing of 30 m permitted the application of 4 times the volume of water than a 100 m spacing. Surface drainage had a smaller effect. More water was able to be treated by applying small amounts frequently than larger amounts less frequently. A properly designed subsurface drainage system lowered the water table depth. DRAINMOD was also useful in predicting drainage outflows and the resulting pollutant load leaving the site. (Cassar-FRC)
W83-01697

PATHOGEN REMOVAL FROM WASTEWATER DURING GROUNDWATER RECHARGE,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
C. P. Gerba, and J. C. Lance.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 137-144, 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Pathogens, *Pathogenic bacteria, *Viruses, *Soil absorption capacity, *Filtration, Adsorption, Wastewater treatment, Land disposal, Microorganisms, Aeration zone, Groundwater pollution, Pullutants, Soil columns, Soil temperature, Soil environment, Soil properties, *Groundwater recharge.

Land application of domestic sewage can ecomomically remove many contaminants so that the water can be reused or discharged to surface or groundwater. The pathogens found in domestic wastewater include pathogenic bacteria, viruses, protozoa and parasitic worms. Bacterial removal by soil largely occurs by filtration at the soil surface. Viruses, being smaller, depend on adsorption for removal and, therefore, are most likely to seep into groundwater during land application. The effectiveness of pathogen removal is determined by their survival in soil and their retention by soil particles which, in turn, are largely determined by climate, nature of the soil, and the nature of the microorganisms. Organisms retained near the soil

surface might be expected to die-off rapidly due to the effects of sunlight, antagonism and drying, while those that penetrate the aerobic zone might have a prolonged survival time. Virus survival is prolonged or increased when virus adsorption to soil increases and with increasing levels of exchangeable aluminum; survival decreases with increasing pH and resin-extractable phosphorus, with temperature increases, and with exposure to aerobic soil microoganisms. Most virus removal occurs in the top few centimeters of soil. Rainfall, pH, soil composition, flow rate, soluble organics, cations, and adsorption characteristics affect the movement of viruses and bacteria in soil. Bacteria removal by soil filtration can be predicted with some accuracy. The adsorption processes are not clearly understood and further work should be centered in this area. (Atkins-Omniplan)
W83-01701

GROUNDWATER RECHARGE - CASE STUDIES; CEDAR CREEK WASTEWATER RECLAMATION AND GROUNDWATER RECHARGE FACILITY, NASSAU COUNTY, NEW YORK,
Nassau County Dept. of Public Works, NY.
For primary bibliographic entry see Field 4B.
W83-01703

RELIABILITY OF WATER FACTORY 21,
Orange County Water District, Fountain Valley, CA.
D. G. Argo, P. L. McCarty, and M. Reinhard.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water RecyclingRecycling, Sacramento, May 1980. p 55-72, 16 Fig, 1 Tab.

Descriptors: *Advanced wastewater treatment, *Water reuse, *Water quality standards, *Reclaimed water, *Wastewater facilities, Injection, Injection wells, Groundwater basins, Effluents, Activated sludge process, Organic compounds, Drinking water, Potable water, Adsorption, Flocculation, *Water Factory 21.

Water Factory 21 (WF-21), in Fountain Valley, CA is an advanced design wastewater reclamation plant which produces up to 15 mgd of reclaimed wastewater for biologically treated secondary effluent. The advanced wastewater treatment (AWT) processes at WF-21 were monitored to determine if they could reliably produce water that meets drinking water standards. They include chemical clarification, air stripping, recarbonation, mixed media filtration, activated carbon adsorption and reverse osmosis. WF-21 operates under constant hydraulic flow conditions and the wastewater to be treated is segregated so that industrial waste contamination is small. Its physical-chemical treatment processes outperform the biological processes which are prone to upsets and lengthy reestablishment times. WF-21 periodically shuts down for maintenance or when performance is substandard. Because the water is injected and stored in the groundwater basin, uninterrupted delivery is not essential, and costly standby processes are avoided. Underground storage also provides time, additional treatment and dilution of some constituents before the water is used. In the last three years, over 40 inorganic and some organic contaminants were measured and estimates made of the percentage of times that the concentration exceeded a given maximum contaminant level (MCL). The only injection water MCL exceeded with any consistency was phenol. Some mineral constituents exceeded the limits but the geometric mean was well below state limits. The study shows that WF-21 can produce reclaimed water which meets current state water quality requirements for groundwater injection. (Atkins-Omniplan)
W83-01704

ROLE OF BACTERIAL EXTRACELLULAR POLYMERS IN METAL UPTAKE IN PURE BACTERIAL CULTURE AND ACTIVATED SLUDGE-II. EFFECTS OF MEAN CELL RETENTION TIME,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. J. Brown, and J. N. Lester.
Water Research, Vol 16, No 11, p 1549-1560, November, 1982. 12 Fig, 2 Tab, 40 Ref.

Descriptors: *Activated sludge, *Klebsiella, *Metals, *Absorption, *Suspended solids, Sludge, Polymers, Bacteria, Activated sludge process, Wastewater treatment, *Biological wastewater treatment, Proteins, Carbohydrates.

The effects of sludge age and dilution rate on extracellular polymer concentrations and metal uptake in activated sludge and continuous cultures of Klebsiella aerogenes were studied under laboratory conditions. In samples extracted from pure cultures of K. aerogenes and activated sludge, polysaccharides and proteins were detected at residual concentrations. Deoxyribonucleic acid was also found at residual levels in samples extracted from activated sludge. At the lowest dilution rate, levels of extracellular polymers in continuous cultures of K. aerogenes increased sharply, while metal uptake by the cells increased slightly, suggesting that increased polymer concentrations enhanced metal absorption. Extracellular polymer levels in activated sludge increased with sludge age, showing a direct relationship with mixed liquor suspended solids. Concentrations of extracellular polymers and mixed liquor suspended solids had no direct effect on metal removal in activated sludge. The ability of sludge to absorb metals increased significantly as sludge age decreased below nine days. (Geiger-FRC)
W83-01711

DIGESTER GAS UTILIZATION AND HEAT RECOVERY IN MEDIUM-SIZED AND SMALL WASTEWATER TREATMENT PLANTS (FAULGASVERWERTUNG UND WARMERUCKGEWINNUNG IN MITTLEREN UND KLEINEN KLARANLAGEN).
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergute und Abfallwirtschaft.
R. Rolle.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 247-250, May 1982. 4 Fig, 1 Tab, 14 Ref. English summary.

Descriptors: *Wastewater facilities, *Energy sources, *Thermal power, *Digested sludge, Biological wastewater treatment, *Wastewater treatment, Sludge, Heating, Primary sludge, Raw wastewater, Clarified wastewater, Seasonal variation.

Ways in which thermal energy prouced in wastewater treatment plants can be used within the plants to save elecric power and heating oil consumption are discussed. Raw wastewater, at 7-15C, provides the greatest volume of energy, but has lost most if its heat by the time it arrives at the plant, and the construction and maintenance of plants to extract and use its heat before arrival are expensive. Biologically treated wastewater (7-15C) can be used, for example to drive a series of heat pumps, as long as treatment is complete; the disadvantage of this is the frequently great distance between secondardary treatment basin and heating plant. Thermally conditioned and pasteurized sludges (160 and 40-70C, respectively) may be used as long as the dewatering capacity of the sludge is not impaired. The best source of energy is digester sludge, which retains a temperature of 27-35C even in winter, and possesses sufficient heat even in plants as small as 25,000 population equivalents to cover winter heat requirements. The principal advantages of using digester sludge are that the raw sludge can be heated and the heat from the digester sludge extracted in physical proximity, and that the digester sludge temperature is not subject to seasonal variation. When a heat pump system is used, even small and medium-sized plants can save on energy purchased from external sources -- at least 13,000 cu m/yr in heating oil and at least 470 GWh/yr in electricity. The heat pump system extracts heat from sludge and transfers it to water so that the water temperature is raised. Digester gas should be used in gas engines to drive air compressors for aeration or three-phase-current generators for energy production. (Gish-FRC)
W83-01746

INCREASING THE DEGREE OF EFFICACY OF WASTEWATER TREATMENT (UBER DIE ERHOHUNG DES WIRKUNGSGRADES DER ABWASSERREINIGUNG),
Vizgazdalkodasi Tudomanyos Kutat Intezet, Budapest (Hungary). Inst. for Water Protection.
P. Benedek.
Gas-Wasserfach Wasser-Abwasser, Vol, 122, No 12, p 572-581, December, 1981. 6 Fig, 10 Tab, 37 Ref. English summary.

Descriptors: *Wastewater treatment, *Activated sludge process, *Activated carbon, *Phosphorus removal, *Hungary, Costs, *Biological wastewater treatment, Pollutants, Aluminum sulfate, Phosphate precipitation.

Laboratory and pilot-scale experiments undertaken by the Central Research Institute for Hungarian Water Management (VITUKI) to aid in the develepment of wastewater treatment technology in that country are reported. Existing technology is inadequate due to increasing industrialization, urbanization, and agricultural development, causing pollution of the Danube River and a danger of eutrophication of Lake Balaton. The most important pollutants that cannot be eliminated by conventional mechanical and biological methods consist of microscopic substances in inorganic (e.g., heavy metals) and organic (e.g., detergents, phenols, chlorinated hydrocarbons) form. Research showed that for small and medium-sized wastewater temperature plants (approximately 10,000 cu m/day), the activated sludge process supplemented with powdered activated carbon was most cost-effective. This process can be introduced with minimal capital outlay and can easily be combined with simultaneous phosphate precipitation with aluminum sulfate. The addition of 50% by weight activated carbon yielded extremely good sludge settling times. The large specific surface of the activated carbon increased the number of active bacteria, and organic compounds not yet broken down (or that were nondegradable), micropollutants, and metabolic products were adsorbed onto the activated carbon. Phosphates were removed by the use of 'Phosphorex,' a process developed by VIKUKI. Sand filtration ws used to increase the efficiency of phosphate removal. Phosphate precipitation after the biological stage immediately followed by filtration proved to be the most effective sequence. (Gish-FRC)
W83-01750

5E. Ultimate Disposal Of Wastes

BIOMASS OF HETEROTROPHIC AND AUTOTROPHIC ORGANISMS AS A FUNCTION OF MODE OF DISCHARGE (SURFACE OR SUBMERGED) OF SEWAGE IN THE BLACK SEA,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 5C.
W83-01414

EFFECTS OF SEPTIC TANK SYSTEMS ON ENVIRONMENTAL QUALITY,
ADI Ltd., Fredericton (New Brunswick).
For primary bibliographic entry see Field 5B.
W83-01438

ENGINEERING ASSESSMENT OF HOT-ACID TREATMENT OF MUNICIPAL SLUDGE FOR HEAVY METALS REMOVAL.
Camp Dresser and McKee, Inc., Boston, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-189655, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-82-014, May 1982. Municipal Environmental Research Laboratory, Cincinnati, Ohio. 4 p, 2 Fig, 2 Tab. 68-03-2803.

Descriptors: *Heavy metals, *Sludge treatment, *Hot acid treatment, *Sludge drying, Land disposal, Disinfection, Cost analysis, Sulfuric acid, Cadmium, Nitrogen, Phosphorus, Organic compounds.

A hot-acid method for treating sludge was developed by the Walden Division of Abcor, Inc., to

remove heavy metals from municipal wastewater sludge. Sulfuric acid is added to the sludge at a rate of about 20 to 30% of the sludge dry solids. The mixture is then heated to 95C for a 30-min reaction time. The hot-acid process effectively solubilizes 50 to 90% of the selected heavy metals, and it produces an essentially pathogen-free product. Based on cadmium application rates stipulated by the U. S. Environmental Protection Agency, land application of the treated sludge requires only a fourth of the land area required by untreated sludge. Primarily because solubilized metals are retained in the aqueous phase entrapped in wet cake, a highly contaminated sludge will still retain substantial concentrations of heavy metals even after treatment. Such sludges might not have concentrations for each metal reduced below the concentrations suggested by the U. S. Department of Agriculture; nevertheless, even for such sludges, potential for utilization on land is increased. A disadvantage of the hot-acid treatment is that in addition to metals, it also solubilizes the nitrogen, phosphorus, and organic contents of the sludge to varying degrees, thus decreasing the fertilizer value of the product. Although improved dewaterability was one of the objectives of the experiment and was borne out in bench-scale tests, a test on a full-scale centrifuge indicated poor dewaterability. The hot-acid treatment of sludge would cost about $440/ton for a 2-mgd wastewater treatment plant and about $140/ton for a 20-mgd plant. Though hot-acid treatment is costly when compared to conventional sludge treatment practices, its cost effectiveness may be good when compared with other systems aimed specifically at controlling the heavy metal contents of sludge.
W83-01561

NITROGEN TRANSFORMATIONS DURING AEROBIC COMPOSTING OF SEWAGE SLUDGE,
New Hampshire Univ., Durham
C. A. Ferraro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150268, Price codes: A05 in paper copy, A01 in microfiche. M. S. Thesis, December 1982, 88 p, 28 Fig, 6 Tab, 19 Ref. OWRT B-006-NH(2), 14-34-0001-0272.

Descriptors: *Sludge composting, *Sludge drying, *Composting, *Sludge disposal, *Nitrogen, *Coliforms, Mineralization, Organic matter, Volatilization, Land disposal, Stabilization.

This study was conducted in an effort to optimize sewage sludge composting to obtain a product with certain desirable characteristics, depending on its ultimate intended use. For landfill, mineralization and volatilization are desirable; for land reclamation, maximum nitrogen maintenance is desirable; and for solid fuel supplement, drying is desirable. Stabilization of organic material and reduction of coliform bacteria were the parameters of interest. Stabilization was defined as mineralization of nitrogen and carbon present in the sludge, via the composting process. Two full-scale field piles were monitored to follow changes in nitrogen concentrations over time. Two experimental parameters, aeration rate and woodchip:sludge ratio, were alternatively varied in an effort to study their effects on the composting process. Carbon concentration, nitrogen concentrations pH, temperature, moisture content, and coliform bacteria were monitored over time. To achieve greatest nitrogen mineralization and total nitrogen reduction, an aeration rate of 400 scfm and a 3:1 or 2:1 woodchip:sludge condition was satisfactory. To achieve least loss of total nitrogen from the system, the nonaerated 1:1 woodchip: sludge piles were best; however, coliform reduction is insufficient. To achieve greatest drying, the aeration rate of 800 scfm and 3:1 conditions was most satisfactory. This configuration also met the coliform reduction requirements. The 3:1 pile also resulted in greatest volatile solids reduction.
W83-01620

ABSORPTION AND TRANSLOCATION OF POLYCHLORINATED BIPHENYLS (PCBS) BY WEEDS.
North Carolina State Univ. at Raleigh.
H. J. Strek, and J. B. Weber.
Proceedings of the Southern Weed Science Society, Vol 33, p 226-232, 1980, 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Weeds, *Polychlorinated biphenyls, *Soil contamination, *Soybeans, *Beets, *Fescue, *Corn, *Sorghum, *Bioaccumulation, Water use, Land disposal, Sludge disposal, Translocation, Absorption.

With the increasing use of sludges as a source of fertilizer, the effect of PCBs upon crop plants and weeds needs to be studied. Soybean, beet, fescue, corn, and sorghum were grown in soil treated with 1000 ppm PCB (Aroclor 1254). Inhibition of height, foliage fresh weight, and cumulative water use was found to be significant for soybean, beet, and fescue, but not for corn and sorghum. Uptake by these crop plants of carbon-14 labelled PCB applied to soil at 20 ppm (corn was grown in soil treated with 25 ppm) varied from 1.0 to 0.008 ppm (wet weight basis). Panicum bisculcatum, a C3 plant, and P. virgatum, a C4 plant were grown in soil treated with 0, 1, 10, 20, 40, and 100 ppm labelled PCB. Adsorption and translocation of PCB to foliage did increase significantly with rate, but no difference between species was noted. Atrazine resistant and susceptible biotypes of Amaranthus retroflexus were grown on soil treated at the same rates in the Panicum study. Absorption and translocation of PCB in plant foliage increased significantly with rate of PCB applied. Height and foliage fresh weight were significantly lower for the susceptible biotype at the 40 and 100 ppm rates, but were significantly lower at the 100 ppm rate only for the resistant biotype. Almost four times as much carbon 14 PCB was found in the foliage of the resistant biotype as was found in the foliage of the susceptible biotype. (Moore-SRC)
W83-01622

OXIDATION-STABILIZATION KEEPS SLUDGE FARM HEALTHY.
For primary bibliographic entry see Field 5D.
W83-01640

LEGAL BATTLE OVER SEPTAGE DISPOSAL,
L. Reeher.
BioCycle, Vol 23, No 4, p 34-35, July/August 1982.

Descriptors: *Septic sludge, *Disposal, *Land application, Legal aspects, Wastewater disposal, Sludge disposal, Sludge, Septic wastewater, Wastewater treatment, Water tanks, Septic tanks.

Since 1980 spetic tank operators have sought various methods of disposal. Only a minority of them have applied to the Department of Environmental Resources for permits for agricultural utilization of septage. Land application is the only positive utilization of septage. Operators in Pennsylvania have a difficult time obtaining land application permits. The most important requirements for the successful use of septage in normal farming operations are landowner arrangements, public acceptance, and a cooperative relationship with municipal officials and regulating agencies. Haulers are calling for total cooperation between agricultural and environmental enforcement groups. They are also asking for programs to educate the public to the practice of agricultural application of sludge. They are also seeking involvement of the United States Department of Agriculture. (Baker-FRC)
W83-01650

HOW TO SOLVE SOLID WASTE AND DRINKING WATER PROBLEMS SIMULTANEOUSLY,
Kuljian Corp., Melbourne, FL.
For primary bibliographic entry see Field 3A.
W83-01667

HAZARDOUS WASTE LANDFILLS: SOME LESSONS FROM NEW JERSEY,
Princeton Univ., NJ. Dept. of Chemical Engineering.
P. Montague.
Civil Engineeering - ASCE, Vol 52, No 9, p 53-56, September, 1982.

Descriptors: *Waste disposal, *Landfills, *Regulations, *New Jersey, Leakage, Leachate, Leaching, Infiltration, Underground waste disposal, Monitoring wells, Groundwater contamination, Water pollution sources.

There are four critical elements for a secure landfill: a bottom liner, a leachate collection system, a cover, and the natural hydrogeologic setting. A faulty liner allows hazardous wastes to migrate into the environment. Non-removed leachate can cause fluids to build up in the basin, and the resulting hydraulic head is the main force that will drive wastes into the environment if the liner fails. An injured cover will allow rain to enter the landfill, solubilizing and mobilizing wastes and causing a buildup of leachate - even to the point of overflowing. In experience gained through four secure landfills operating in New Jersey it was determined that synthetic liners are prone to problems and that clay liners also present difficulties. Landfill covers are prone to attack from erosion, vegetation, soil-dwelling mammals, sunlight, subsidence, and human activities. (Baker-FRC)
W83-01670

DRAINAGE SYSTEMS FOR LAND TREATMENT OF WASTEWATER,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W83-01697

5F. Water Treatment and Quality Alteration

TOXIC COMPOUNDS FORMED BY THE CHLORINATION OF ARIZONA SURFACE WATERS,
Arizona Univ., Tucson. Dept. of Chemistry.
M. A. Mikita, K. Thorn, L. Irwin, and C. Steelink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150037, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, 1982. 27 p, 7 Fig, 6 Tab, 27 Ref, 1 Append. OWRT A-094-ARIZ(1), 14-34-0001-0103.

Descriptors: *Chlorination, *Ozonation, *Fulvic acids, *Humic acids, *Halogenated hydrocarbons, *Mutagens, *Phenols, *Arizona, Drinking water, Carcinogens, Organic compounds, Disinfection, Tannic acids, Lignin, Rutin, Spectroscopy, Colorimetry.

The two major organic constituents of drinking water, humic and fulvic acids, produce chloroform and other toxic halocarbons when they are chlorinated. Little is known about this reaction, because the chemical structures of these polymeric acids are obscure. A new method was developed for elucidating important structural features in these compounds. Upon treatment with C-13 enriched methylating reagents, aquatic humic substances form methyl derivatives. These derivatives can be analyzed by C-13 NMR spectroscopy. They reveal the nature and abundance of the phenolic, acidic and carbohydrate groups in humic and fulvic acids. These properties will help predict the interactions of humates with their chemical and aquatic environment and help classify humic materials on a rational, structural basis. Ozone has been proposed as an alternative disinfectant to chlorine. However, it is not known whether mutagenic compounds are produced by the ozonization of organic matter in water. Therefore, a study of the mutagenicity of a number of phenolic compounds was carried out, before and after ozone treatment. The list of compounds included humic and fulvic acids, tannic acid, lignin, rutin and simple phenols. Bacterial mutagenicity was determined by the Ames test, which correlates with carcinogenicity in animals at a 90% level. None of the compounds was mutagenic, with the possible exception of rutin. After ozonization, only lignin revealed mutagenic activity after two minutes of ozone treatment. A new, rapid method for estimating total phenol content has been developed. It is based on the selective absorption of phenols by XAD-8 resins, and the

estimation of phenol concentration by the Folin-Ciocalteau colorimetric assay. (Moore-SRC)
W83-01531

BIOLOGICAL PROCESSES IN THE TREATMENT OF MUNICIPAL WATER SUPPLIES,
Jacobs Engineering Group, Washington, DC.
R. G. Rice, C. M. Robson, G. W. Miller, J. C. Clark, and W. Kuhn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199704, Price codes: A19 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-82-020, May 1982. Municipal Environmental Research Laboratory, Cincinnati, Ohio. 6 p, 1 Fig, 1 Tab. R-804385-01.

Descriptors: *Water treatment, *Oxidation, *Filtration, *Activated carbon, *Biological treatment, *Drinking water, Ozonation, Aeration, Ammonia, Organic carbon, Rapid media filtration, Adsorption, Halogenated hydrocarbons, Europe.

Studies were conducted of a European water treatment technique that appears to produce high quality drinking water without the synthesis of halogenated organic materials during the water treatment process. This biological treatment technique involves the sequential application of chemical oxidation (usually by means of ozone), rapid media filtration, optional reaeration, and granular activated carbon (GAC) adsorption. The use of this biologically enhanced, granular activated carbon (BEGAC) technology was studied in several European water treatment plants to determine its advantages and disadvantages for use in the United States. Seven European water works were visited where chemical preoxidation is followed by rapid media filtration and GAC adsorption. The process is still under development in these European water works, but results to date are positive. They indicate that in those water works using GAC adsorption of dissolved organic materials, incorporation of chemical preoxidation with small amounts of ozone (1 to 2 mg/L) can result in extending the life of GAC adsorbors by factors of 4 to 6 before reactivation is required. The process can be used for the biological removal of ammonia from raw water supplies and has replaced breakpoint chlorination in several European plants. Such replacement eliminates the prechlorination step, which in turn eliminates the formation of significant quantities of halogenated organics. Results to date indicate that after biological equilibrium is attained in GAC adsorbers, 25 to 35% of the influent dissolved organic carbon is removed from solution biologically.
W83-01563

ASSESSING MICROBIALLY MEDIATED WATER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and G. D. Boardman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150052, Price codes: A10 in paper copy, A01 in microfiche. Completion Report, 206 p, 31 Figs, 34 Tabs, 75 Refs, 3 Appendi. OWRT B-120-VA(1).

Descriptors: *Water Treatment, *Distribution Systems, Water Quality, *Disinfection, *Bacterial Contamination, Potable Water, Water Quality Deterioration, *Water Utilities, Chlorine residuals.

This research sought to provide a review of various aspects of water quality problems that develop in distribution systems during water transmission by surveying water utility problems and responses to customer complaints and by conducting field monitoring studies of water quality concerns and laboratory studies related to monitoring and control techniques. Specifically, the study assessed the potential for microorganisms to biologically mediate chemical changes in distribution systems; investigated the use of concentration techniques for providing a representative microbial sample from distribution systems; examined the use of chlorine and other disinfectants for control of microorganisms. The study concludes that most water utilities lack fundamental data necessary to assess accurately water quality problems in distribution systems; that a comprehensive sampling and monitoring program is often needed in distribution systems to identify those chemical and microbial constituents that are the principal causes of quality problems; that better maintenance of chlorine residuals is needed in distribution systems; that concentration techniques hold promise for aiding the assessment of water quality problems in distribution systems.
W83-01573

THE IMPACT OF NON-HAZARDOUS SUBSTANCES IN SURFACE WATER ON DRINKING WATER QUALITY (AUSWIRKUNGEN PRIMAR NIGHT GESUNDHEITSSCHADIGENDER STOFFE IM OBERFLACHWASSER AUF DIE TRINKWASSERBESCHAFFENHEIT).
Bundesgesundheitsamt, Berlin (Germany, F.R.) Inst. fuer Wasser-, Boden-, und Lufthygiene.
U. Hasselbarth.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 151-156, June 1982, 9 Fig, 24 Ref.

Descriptors: *Drinking water, *Water treatment, *Algal growth, *Eutrophic lakes, Flocculation, Filtration, Phosphorus removal, Activated carbon, Disinfection, Chlorination, Algal control, Water quality, Odor-producing algae, Odor control, Taste, Oxidation-reduction potential, Degradation products.

Products of algal meabolism and degradation can interfere with the preparation of drinking water taken from eutrophic lakes and reservoirs. Controlled floccculation with iron or aluminum salts and organic media can remove algae almost entirely, and this should be done even though algal products in drinking water pose no health hazards, since they can produce unpleasant odors and taste. Flocculation is unsuccessful when algal products reacting with the flocculation medium do not form insoluble compounds, but form soluble salts or cheltates. This may be alleviated by reducing the pH value or by multiple flocculation at different pH levels. Products remaining in water after flocculation reduce the efficacy of disinfection where the oxidation-reduction potential is greatly reduced and favor algal regrowth in storage tanks and pipelines. Most algal products are deoxidizing agents and impair disinfection by consuming chloride or chlorine dioxide, resulting in the production of trihalomethanes with chlorine or other harmful substances with chlorine dioxide. This problem may be alleviated if the water is pretreated by phosphorus elimination or by flocculation, filtration, and activated carbon treatment. Regrowth of algae in drinking water is usually treated by extra chlorination, which results in an unpleasant taste and often in chlorine concentrations that exceed the maximum allowed by law. A better method is to prevent algal mass development in the reservoir by phosphorus elimination. The development of methods for quantifying nutrient availability needs to be addressed. (Gish-FRC)
W83-01586

A COMBINED PROCEDURE OF PHOSPHATE ELIMINATION AND THE EFFICIENCY OF ADDITIVES: PLANTS IN BERLIN (VERFAHRENSKOMBINATION ZUR PHOSPHATELIMINATION AN DEN BERLINER SEEN UND DIE EFFIZIENZ VON ZUSATZSTOFFEN),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden-, und Lufthygiene.
A. Grohmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, P 121-122, 127-131, June, 1982. 6 Fig, 1 Tab, 12 Ref. English summary.

Descriptors: *Phosphorus removal, *Lakes, *Water treatment facilities, *Water quality control, Berlin, *Federal Republic of Germany, Flocculation, Chemical precipitation, Destabilization, Automation, Water treatment.

Phosphate elimination facilities at two Berlin (Federal Republic of Germany) lakes, Wannsee and Tegeler See (TS), are described, and experimental results providing information on the efficiency of the methods used are given. The smaller plant is already operating (Wannsee, 1,200 cu m/hr), while the larger (22,000 cu m/hr) is under construction. Both facilities incorporate destabilization of suspended solids, phosphate precipitation with iron or aluminum salt solutions, and finally separation of the flocs produced. Design difficulties were experienced with the TS plant due to the necessity of allowing for variations in water quality and volume and for peak storm inflow. Flocculation takes place in pipes rather than in basins with mixers. Experiments with water taken from the channel to be treated by the TS plant resulted in a residual concentration of total phosphate of < 0.3 mmol/cu m (< 10 microg/l phosphorus, P), 0.3 mmol/cu m being the maximum residual phosphate allowed by Berlin law. P concentration in the inflow was 0.2-0.4 mol/cu m, originating in irrigation fields; this level is consistent with wastewater-treatment-facility effluent, which cannot usually be treated so effectively. Phosphate precipitation and solids or colloids destabilization are to be viewed as independent reactions that both occur rapidly without influencing each other. Control of a phosphate-elimination facility like that at TS requires automatic analysis of phosphate concentration in the inflow and a flocculation test device for continuous monitoring. (Gish-FRC)
W83-01600

THE MECHANISMS OF POLIOVIRUS INACTIVATION BY CHLORINE DIOXIDE AND IODINE AND THE EFFECTS OF CATIONS ON HALOGEN INACTIVATION,
New Mexico State Univ., Las Cruces. Dept. of Biology.
M. E. Alverez, and R. T. O'Brien.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150102, Price codes: A04 in paper copy, A01 in microfiche. NMWRRI Technical Report No 152, June 1982. 55 p, 18 Fig, 2 Tab, 62 Ref. OWRT A-066-NMEX(1), 14-34-0001-1133.

Descriptors: *Wastewater treatment, *Virus inactivation, *Poliovirus, *Halogen, Chlorine, *Iodine, *Chlorine dioxide, *Cations.

Chlorine dioxide and iodine inactivated poliovirus most efficiently at pH 6. Sedimentation analyses of viruses inactivated by chlorine dioxide or iodine at pH 10 showed that viral RNA separated from the capsids converting the 156S virions to 80S particles. However, the separation of the RNA from the capsids was not the cause of virus inactivation. The RNA released co-sedimented with intact 35S viral RNA. Both chlorine dioxide and iodine reacted with the capsid proteins changing the isoelectric point. However, the mechanisms of virus inactivation by chlorine dioxide and iodine were different. Iodine impaired their ability to absorb to HeLa cells; whereas chlorine dioxide-inactivated viruses were able to absorb, penetrate, and initiate uncoating normally. Cells infected with chlorine dioxide-inactivated viruses showed a reduced incorporation of 14C uridine into new viral RNA. Therefore, chlorine dioxide-inactivated poliovirus by reacting with the virus RNA and impaired the ability of the genome to act as a template for RNA synthesis. The presence of 0.1 M KCl or 0.1 M mgCl2 enhanced the rate of inactivation of poliovirus by chlorine but not by iodine. Inactivation of poliovirus by chlorine dioxide was reduced in the presence of salts at pH 10 but not at pH 6. Salts inhibited the separation of the RNA from the viral capsids when viruses were inactivated in their presence. Moreover, the presence of MgCl2 was found to stabilize chlorine or chlorine dioxide-inactivated viruses in a 120 to 130S RNA-containing structure. The rates of inactivation of poliovirus by halogen compounds, and the gross structural changes associated with virus inactivation, appear highly dependent on the pH of the reaction and on the ionic environment.
W83-01602

TREATMENT TECHNOLOGY TO MEET THE DRINKING WATER STANDARDS FOR TRIHALOMETHANES FOR JACKSON, MISSISSIPPI; PART II, CHLORAMINES AS ALTERNATE DISINFECTANTS: STATE-OF-THE-ART REVIEW,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
A. Shindala.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150276, Price codes: A05 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute Report, September 1982, 79 p, 22 Fig, 21 Tab, 33 Ref.

Descriptors: *Trihalomethanes, *Chloramines, *Disinfection, *Chlorination, *Water treatment, *Drinking water, Halogenated hydrocarbons, Bacteria, Protozoa, Viruses, Sedimentation, Residual chlorine.

A three-month search of the literature on the effectiveness of chloramines as primary disinfectants was carried out, as well as site visits to four water treatment facilities utilizing either chloramines as the sole disinfectant or a combination of short-term free chlorination followed by chloramines. The two options that appear most promising include: the use of chloramines as the sole disinfectants; and moving the point of prechlorination to past settling followed by chloramines into the distribution system. Although chloramines have been successfully used by some utilities as the sole disinfectants, the literature clearly indicates that chloramines are weak disinfectants against bacteria, and ineffective against viruses and protozoa. Chloramines may not provide a barrier against exposure of the public to a poorly disinfected water, particularly in cases where there is a potential for sewage contamination of the source water, as is the case for Jackson, Mississippi. Moving the point of prechlorination to past settling followed by chloramines allows for the maintenance of free residual chlorine between the top of the filters and the entrance into the distribution system. The free residual will be mainly in the form of hypochlorous acid, which is the most powerful bactericide of all available chlorine species. There is a possibility of violating the total trihalomethanes criteria at certain times of the year. (Moore-SRC)
W83-01623

TREATMENT TECHNOLOGY TO MEET THE DRINKING WATER STANDARDS FOR TRIHALOMETHANES FOR JACKSON, MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
A. Shindala, and B. A. Mowry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150284, Price codes: A11 in paper copy, A01 in microfiche. Mississippi Water Resources Research Intitute Report, February 1982. 217 p, 43 Fig, 26 Tab, 59 Ref, 5 Append. OWRT B-209-MS(2), 14-34-0001-1240.

Descriptors: *Water treatment, *Trihalomethanes, *Halogenated hydrocarbons, *Chlorination, *Chlorine dioxide, *Chloramines, *Disinfection, *Cost analysis, Drinking water, Ammoniation, Potassium permanganate, Oxidation, Ozone, Hydrogen peroxide, *Mississippi Jackson.

The City of Jackson, Mississippi, acquires the bulk of its water from the Pearl River. Test results from phase three of the National Organic Reconnaissance Survey indicated total trihalomethanes (TTHM) concentrations in the finished water in excess of the recommended level of 100 ppb. To arrive at an optimum solution to the TTHM problem, a study was initiated with the primary objective of delineating the most cost effective treatment sequence of meeting the EPA requirement for TTHM without sacrificing other water qualify criteria. Studies on the removal of precursors, prevention of trihalomethane (THM) formation, and post treatment for the removal of THM produced were planned. Both batch as well as pilot plant studies were utilized. Process modifications studied through pilot plant operation included relocation of the chlorine application point; chlorination/ammoniation; chlorination/potassum permanganate oxidation; and chlorine dioxide utilization. Bath studies included jar tests to determine the optimum conditions for coagulation; rate of THM formation studies to evaluate the effects of temperature, pH and chlorine dose on the rate of formation; aeration studies as a post treatment method for the removal of THMs; and oxidation studies through ozone, hydrogen peroxide, chlorine dioxide and potassium permanganate to assess the effects of these oxidizers on precursors removal. Results indicated that chloramines, as a substitute for the prechlorination process, are the most cost effective and implementable option that will satify the objectives of controlling the THM formation as well as providing the necessary disinfection to meet the allowable limits for bacteriological quality. (Moore-SRC)
W83-01625

THM PRECURSORS REMOVAL SURFACE WATERS USING OZONE HYDROGEN PEROXIDE OXIDATIONS,
Louisiana Tech Univ., Ruston, Dept. of Chemical Engineering.
J. B. Fernandes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150300, Price codes: A02 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute Report, July 1982, 18 p, 5 Fig, 16 Ref. OWRT A-051-LA(1), 14-34-0001-1120.

Descriptors: *Oxidation, *Ozone, *Hydrogen peroxide, *Water treatment, *Trihalomethanes, Halogenated hydrocarbons, Hydrogen ion concentration, Drinking water, Cost analysis, Reaction time.

Trihalomethanes are known to be formed when chlorine is used as a disinfecting agent in drinking water treatment plants. In order to reduce the formation of trihalomethanes, three alternatives are possible: the removal of precursors prior to chlorination; the removal of trihalomethanes after chlorination of water; or the use of disinfectants other than chlorine. In order to establish optimum conditions for trihalomethane precursor removal via hydrogen peroxide catalyzed ozonation, laboratory studies were carried out. Results indicate that the optimum value to obtain maximum removal of precursors from natural water at a minimum ozone comsumption level is 20 mg/1 for hydroge peroxide. At times greater than 1 hour, the reduction in trihalomethanes is not significant as compared to the additional costs which would be incurred due to the increased residence time. The reduction in trihalomethanes is maximum at a pH value near 7. The concentration of ozone in the liquid phase steadily increases as the reaction progresses. Ozone is transferred from the gas phase into the liquid phase due to the concentration gradient. Part of this ozone reacts with humic and other materials in the water, part in decomposed and the rest remains unreacted. (Moore-SRC)
W83-01626

THE INFLUENCE OF MODERN WATER SUPPLY AND WASTEWATER TREATMENT SYSTEMS ON WATER QUALITY IN MICRONESIA,
Guam Univ., Agana. Water and Energy Research Inst.
P. A. Cowan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150359, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 36, August 1982. 96 p, 30 Fig, 44 Tab, 6 Ref. OWRT A-020-GUAM(2), 14-34-0001-0112, 14-34-0001-1112.

Descriptors: *Marine Environment, *Water pollution, *Public health, *Drinking water, *Water treatment, *Water quality, *Micronesia, *Wastewater treatment, Bacteria, Turbidity, Chlorination, Sanitary wastewater.

Approximately 40% of the population of the Trust Territory of the Pacific Islands is concentrated in seven district centers. A major destructive force upon the integrity of the marine environments surrounding these areas of high population density is the failure to collect, treat and dispose of human wastes. The marine evironment immediately surrounding the district centers of Palau (Koror) nd Ponape (Kolonia) were each evaluated for a period of approximately one month. Specific water quality parameters quantified included: total and fecal coliforms; water temperature; salinity; pH; turbidity; and dissolved oxygen. Since the principal water quality monitoring priority in the Trust Territory is the continued evaluation of the district center Public Water System, a concurrent monitoring program was maintained to study the bacteriological and physical integrity of the drinking water distribution system. In Koror, those areas immediately east and west of T-dock and the small bay adjoining the Community Club should experience improvements in water quality, given implementation of a fully operational wastewater system. In Kolonia, all near shore marine areas should be positively impacted. The waters surrounding Ponape, a high island, will continue to suffer from high turbidities during sustained rainfall events. Numerous drinking water standard violations were measured in each system. The systems in Colonia (Yap) and Koror are operated on an intermittent basis and, as such, patrons should boil water prior to culinary use. The service in Kolonia is continuous; however, until improved chlorination practices at the water treatment plant are effected, boiling should be mandatory. (Moore-SRC)
W83-01631

PREFORMED MAGNESIUM HYDROXIDE PRECIPITATE FOR SECOND-STEP CONCENTRATION OF ENTEROVIRUSES FROM DRINKING AND SURFACE WATERS,
Service de Controle des Eauz de la Ville de Paris (France).
P. Vilagines, B. Sarrette, and R. Vilagines.
Canadian Journal of Microbiology, Vol 28, No 7, p 783-787, July, 1982. 6 Tab, 15 Ref.

Descriptors: *Enteroviruses, *Concentration, *Water treatment, Drinking water, Potable water, Natural waters, Viruses, Purification, Water quality, Magnesium hydroxide.

A method is described for the second-step concentration of viruses from large volumes of drinking and surface waters. Seeded viruses present in the first eluate, performed with a 50 mM glycine buffer, pH 11.5, were absorbed on a preformed magnesium hydroxide precipitate. After low-speed centrifugation they were desorbed and adjusted to pH 7 with McIlvaine citrate-phosphate buffer. In these experimental conditions 90% of the viruses present in the 300 mL first eluate were reconcentrated in a final volume of 40 mL. The recovery efficiency was independent of either virus concentration or water quality. (Baker-FRC)
W83-01645

APPROPRIATE TECHNOLOGY TO IMPROVE DRINKING WATER QUALITY IN MOSUL, IRAQ,
Mosul Univ. (Iraq).
S. Ahmad, M. T. Wais, and F. Y. R. Agha.
Aqua, No 4, p 439-444, 1982. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Turbidity, *Water treatment, *Sand filters, *Sedimentation, *Water quality control, *Pretreatment of water, Filtration, Alum, Water conveyance, Developing countries, Chlorination, Coagulation.

Studies reveal that the turbidity of water drawn from surface sources can be considerably reduced by pretreatment using sedimentation processes. Alum coagulation followed by rapid sand filtration will offer reduced turbidity and high bacteriological quality. Superchlorination of treated water may not be necessary during periods of high turbidity. The water can be prepared for direct application to slow sand filtration by providing long settling periods. This also allows less shock to be placed on unit operations due to a sudden increase in turbidity. Reduction of turbidity at the initial stages of treatment saves on the amount of alum used, while freeing the water supply system of deposits. This allows better flow, less wear and tear on pipe materials, and no deposits at the bottom of roof cisterns. A pretreatment stage of plain sedimentation acts as a buffer against changes in river water quality and provides a reserve supply of water during an emergency. Plain sedi-

mentation may be especially useful in developing countries where skilled plant operation for the control of alum coagulation is sometimes limited. (Geiger-FRC)
W83-01646

SIMPLE WATER TREATMENT PROCESSES (WITH SPECIAL REFERENCE TO FILTRATION AND DISINFECTION),
International Inst. for Hydraulic and Environmental Engineering, Delft (Netherlands).
C. J. Vaillant.
Aqua, No 4, p 431-437, 1982. 7 Fig, 5 Ref.

Descriptors: *Water treatment, *Disinfection, *Sand filters, *Economics, *Pretreatment of water, *Drinking water, Chlorination, Filtration, Water conveyance, Groundwater mining, Performance evaluation, Raw water.

Simple water treatment processes are characterized by simplicity of construction, operation and maintenance, and reliability, with good performance efficiency and effluent quality. Hygienically safe groundwater is generally the preferred raw water source for water supply systems. When surface water is the only available source of raw water, it must be disinfected before potable use. Usually chlorination cannot be applied as the sole treatment step. Pretreatment by rapid filtration is often required. Slow sand filtration may be the most reliable and economic purfication method for preparing safe drinking water in many countries. Slow sand filtration, however, has large space requirements, higher initial investments, low flexibility, algal buildup, and problems of ferrous and manganous compound release. Some flow schemes for groundwater and surface water treatment are outlined. Often, simple water treatment processes can be successfully used under local circumstances in place of more complex systems. (Geiger-FRC)
W83-01649

EVALUATING WATER TREATMENT TECHNIQUES FOR BARIUM REMOVAL,
Metcalf and Eddy, Inc., Des Plaines, IL.
T. L. Krause, and E. L. Stover.
Journal of the American Water Works Association, Vol 74, No 9, p 478-485, September, 1982. 6 Fig, 13 Tab, 7 Ref.

Descriptors: *Barium, *Ion exchange, *Chemical precipitation, *Water treatment, Lime, Water softening, Direct filtration, Filtration, Costs.

Ion exchange, lime softening, and chemical precipitation-direct filtration were effective in removing barium from well water in northern Illinois. However, estimated total annual equivalent costs for a 66 liter per sec treatment system were much lower for the ion exchange system ($157,200) than for lime softening ($429,800) and chemical precipitation-direct filtration ($472,700). Barium levels in the well water were 7-8 mg per liter at first flush, stabilizing to 5-6 mg per liter after 2 hours pumping. These levels are considerably higher than the 1 mg per liter maximum contaminant level specified by the Safe Drinking Water Act. Source of the Ba ions is natural leaching from the Cambrian-Ordovician aquifer. Ba removals were $>$ 94% for the ion exchange process, up to 95.6% for the chemical precipitation-direct filtration process, and about 94% for lime softening. (Cassar-FRC)
W83-01651

THE CASE FOR EUROPE'S DISINFECTION PRACTICES,
C. J. Morris.
Consulting Engineer (St. Joseph), Vol 59, No 3, p 85-88, September, 1982. 1 Fig.

Descriptors: *Drinking water, *Water treatment, *Disinfection, *Europe, United States, Regulations, Chlorination, Ozonation, Activated carbon, Adsorption, Disinfectants.

A steady divergence of philosophy and practice with regard to drinking water disinfection has been noted between Europe and the United States. In the US almost total reliance is placed on chlorination, while in Europe great emphasis is found on the use of ozone. Europe displays a greater tendency toward employing two or more oxidant-disinfectants, together with multiple dosing points. Europe calls for regulation of a maximum disinfectant residual in the finished water, while the US calls for a minimum residual reaching the consumer. In recent developments Europeans appear less constrained by budgetary consideration than US planners. Quality goals are set first, and then the most economic plan for meeting those goals is sought. Thus in Europe there is a greater emphasis on achieving the best feasible water quality, rather than simply on meeting minimum acceptable standards of quality as exemplified by maximum contaminant levels. These considerations appear to account for the facts that granular activated-carbon has become much more readily accepted as a technique in Europe than in the US and that multiple use of disinfections is so much further advanced there. (Baker-FRC)
W83-01652

CHLOROPHYLL--A RAW WATER QUALITY PARAMETER,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W83-01657

HEALTH EFFECTS OF DRINKING WATER DISINFECTANTS AND DISINFECTANT BY-PRODUCTS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W83-01740

THE NECKAR AS SUPPLIER OF INDUSTRIAL AND BACKUP WATER (DER NECKAR ALS LIEFERANT VON BETRIEBS-UND RESERVEWASSER),
Technische Werke der Stadt Stuttgart A.G. (Germany, F.R.).
K. E. Oehler.
Gas-Wasserfach Wasser-Abwasser, Vol 122, No 12, p 566-571, December, 1982. 2 Fig, 5 Tab. English summary.

Descriptors: *Industrial water, *Neckar River, *Water quality, *Water delivery, Water distribution, Water supply, *Drinking water, Potable water, *Federal Republic of Germany, Stuttgart, Lake constance, Costs, Water treatment, Water supply development, Rivers.

Water from the Neckar River was first used to supply the city of Stuttgart (Federal Republic of Germany) with drinking water in 1882, but after World War II this became problematic due to pollution of the river by wastewaters. After the Lake Constance water distribution system went into operation in 1958, regular use of the Neckar for drinking water was no longer necessary. The proposal to supply households with less-than-fully treated Neckar water for non-drinking purposes was rejected because this water might be drunk mistakenly or to save money (being cheaper than drinking water), to avoid duplication of the water distribution system, and because even some non-drinking water would have to be supplied from remote sources, and thus it had neither ecological nor economic advantages. Instead, industrial-quality water was delivered from the Neckar to a few large-volume users relatvely close to the supply source. In an emergency, the Neckar water-works would be capable of supplying drinking water. Analysis of Neckar water done in 1980 showed that for most parameters, it fell into the EEC A1 category (simple physical treatment and disinfection required); parameters causing water quality to be below this standard were coloration (green color caused by eutrophication of dammed sections), iron, manganese, ammonium concentration, phosphate, and odor. Ammonium and phoshate were the only parameters in serious violation of A1 standards. Water treatment of the Neckar consists of chlorination (2-5 g/cu m), flocculation with aluminum sulfate (30-50 g/cu m), sedimentation, fast and slow filtration, and activated carbon treatment (the last-mentioned only in the case of drinking water preparation). This treatment and the short distribution distances have allowed this non-drinking water to be supplied at half the cost of drinking water. (Gish-FRC)
W83-01749

5G. Water Quality Control

CHARACTERIZATION OF AQUIFERS DESIGNATED AS POTENTIAL DRINKING WATER SOURCES IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W83-01403

DETERMINATION OF SENSITIVITY OF WATER QUALITY PARAMETERS FOR STREAM POLLUTION CONTROL,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
C. G. Wen, J. F. Kao, L. K. Wang, and M. H. Wang.
Journal of Environmental Management, Vol 14, No 1, p 17-34, January, 1982. 20 Ref.

Descriptors: *Systems analysis, *Sensitivity analysis, *Dissolved oxygen, *Biochemical oxygen demand, Fate of pollutants, Water pollution control, Alternative planning, Decision making, Tidal rivers, Rivers, Streams, Model studies, Oxygen, Oxygen deficit, Nitrification, Phytosynthesis, Bottom sediments, Uptake, Mixing, Aearation, Dispersion coefficient.

Formulas were derived to help decision makers select a preferred water pollution control alternative by means of system analysis of sensitivity. For tidal and nontidal streams relationships were described mathematically for the sesitivity of: BOD to deoxygenation coefficient, dissolved oxygen (DO) deficit to deoxygenation coefficient, DO deficit to nitrification coefficient, CO deficit to photosynthesis rate, DO deficit to bottom deposit uptake rate, DO deficit to reaeration coefficients, BOD to longitudinal dispersion coefficients, and DO deficit to longitudinal dispersion coefficients. (Cassar-FRC)
W83-01413

AERATION OF WATER SUPPLIES FOR FISH CULTURE IN FLOWING WATER,
Mansfield State Coll., PA. Dept. of Biology.
R. W. Soderberg.
Progressive Fish-Culturist, Vol 44, No 2, p 89-93, April, 1982. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Aquaculture, *Aeration, *Dissolved oxygen, Fish, Oxygen requirements, Oxygen transfer.

Reaeration methods for flowing water in aquaculture are reviewed and analyzed. Efficiencies of some gravity devices are: simple weir, 6-12%; inclined corrugated sheet, 25-43%; inclined corrugated sheet with holes, 30-50%; splashboard, 14-38%; lattice, 34-56%; and cascade, 23-52%. These can be calculated from a formula based on actual increases in dissolved oxygen and possible increases in dissolved oxygen. The formula can be rearranged to solve for expected dissolved oxygen concentrations from an aeration device of known efficiency. An equation is given to calculate oxygen transfer by mechanical devices such as surface aerators. It can also be used to determine the required size of a unit or to determine the energy costs for operation. Oxygen requirements of fish are dicsussed. At a dissolved oxygen tension of 70-90 mm Hg, water used in fish culture must be reconditioned by aeration. The minimum dissolved oxygen varies with fish species, water temperature, and elevation above sea level. (Cassar-FRC).
W83-01422

AN ASSESSMENT OF ALTERNATIVE WATER QUALITY POLICIES: THE BEDFORD-OUSE CASE STUDY,

Florence Univ. (Italy). Ist. di Informatica e Sistemistica.
S. Marsili-Libelli.
Journal of Environmental Management, Vol 14, No 4, p 375-388, July, 1982. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Water quality, Management, *Effluent limitations, Optimization, Bedford River, Ouse River, *England, Biological oxygen demand, Dissolved oxygen, River basins.

Two approaches to water quality management for the Bedford-Ouse system were compared. These alternatives were: a coordinated policy, in which the discharge of each treatment plant is determined in context of the entire basin requirements, and a fixed discharge design where discharges are set to a common value, disregarding their effects on the receiving water. Four treatment plants with flows of 0.23-0.62 cu m per sec and an 80 km reach were considered. The advantages and cost effectiveness of the coordinated approach and the limits of the fixed discharge scheme were clearly demonstrated. Although the coordinated approach would cost 10% more than the fixed discharge scheme, it would maintain dissolved oxygen at > 5 mg per liter for the 80 km section of the river. The fixed discharge scheme would gradually decrease dissolved oxygen to zero after 30 km. Similarly, BOD levels would vary from 0 to 8 mg per liter in the coordinated approach; and from 3 to 14 mg per liter with fixed discharge. (Cassar-FRC)
W83-01432

A DESIGN FOR AQUATIC MONITORING PROGRAMS,
Battelle Pacific Northwest Labs. Richland, WA.
J. R. Skalski, and D. H. McKenzie.
Journal of Environmental Management, Vol 14, No 3, p 237-251, May, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Monitoring, *Experimental design, *Nuclear powerplants, Powerplants, Statistical analysis, Plankton, Benthos, Control-treatment pairing, Aquatic populations, Errors, Graphical analysis, Water pollution effects.

A control-treatment pairing (CTP) design for aquatic monitoring at nuclear powerplants is presented for impact assessment in benthic and plankton communities. It accounts for the constraints operating on a monitoring program: site specific environmental characteristics, quantitative objectives of the monitoring program, experimental error, and limitations of time and effort. The competing constraints are incorporated into the design of aquatic monitoring studies by a graphical technique. Most monitoring programs can be defined by 2 levels of plant operating status; 1 or 2 levels of sample collection depth; 4, 6, or 12 levels of sampling times; 1 to 5 levels of depth contours; and 1 or 2 levels of position of station pairs relative to the nuclear powerplant. The estimates of experimental error calculated from application of CTP design to benthic and plankton communities at 6 nuclear powerplants are given. A CTP monitoring program design as 3 distinct advantages over a traditional unpaired design in that it: (1) establishes a relationship between biota changes and powerplant operation, (2) designates control-treatment observations made in several years as replications, and (3) reduces experimental error. (Cassar-FRC)
W83-01437

CHANGE IN LAKE TROPHIC STATE AND INTERNAL PHOSPHORUS RELEASE AFTER ALUMINUM SULFATE APPLICATION,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke, R. T. Heath, R. H. Kennedy, and M. R. McComas.
Water Resources Bulletin, Vol 18, No 4, p 699-705, August, 1982. 3 Fig, 10 Tab, 21 Ref.

Descriptors: *Trophic state, *Lake restoration, *Aluminum sulfate, Sulfates, Lakes, Eutrophication, Mesotrophic lakes, Phosphorus, Nutrients, Ohio, Dimictic lakes, West Twin Lake, Dollar Lake.

The effectiveness of a maximum hypolimnetic dose of aluminum sulfate, defined as that amount of alum which can be added to a lake with carbonate alkalinity until the concentration of dissolved aluminum reaches 50 micrograms Al/liter, in controlling the release of P from anaerobic sediments and in improving lake trophic state was evaluated. The treatment proved effective, as evidenced by lowered lake concentrations and reduced rates of internal P release. The treated lakes shifted from eutrophic to mesotrophic and exhibited increases in algal phyla other than Cyanophyta. One lake, West Twin, experienced a significant reduction in species diversity of plantonic microcrustacea, and there was a lakeward extension of the macrophyte community. The treatment appears to have longevity. Internal P release continued during summer months. Four years after treatment, Dollar Lake exhibits indications of a decrease in effectiveness of the aluminum hydroxide layer, as evidenced by doubling of the hypolimnetic phosphorus concentration between 1976 and 1978. This lake restoration technique appears to have great promise as a means of accelerating lake recovery following diversion of nutrient income. (Baker-FRC)
W83-01473

A PROTOTYPE COMPUTER INTERACTIVE GROUND WATER MONITORING METHODOLOGY FOR SURFACE WATER IMPOUNDMENTS,
Kaman Tempo, Santa Barbara, CA.
L. G. Everett, and W. O. Rasmussen.
Water Resources Bulletin, Vol 18, No 4, p 605-612, August, 1982. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater, *Water quality, *Monitoring, Computers, Coal mining, *Mine wastes, Groundwater pollution, *Computer programs.

An approach to developing a groundwater monitoring program for coal strip mine operations has been developed. The method has evolved over the past few years, and involves a computer program which automates components of that methodology. This interactive computer program is designed to be operated by persons with little, if any, previous exposure to computers. The method is comprised of several steps. Associated with each step are several objectives that are to be met. Finally, there are numerous alternative monitoring methods available for meeting each objective. For a given step and objective the user is presented with a description of the principle involved with each alternative method, the advantages and disadvantages of each method and the associated cost. The user is then queried as to which method is now being used and which he wishes to use in the future for his specific mine sites. The totality of the alternative methods is the tailor-made overall groundwater monitoring design he has assembled for his mine site. (Baker-FRC)
W83-01474

GEOMETRIC VARIATIONS IN RESERVOIR WATER QUALITY,
Massachusettes Inst. of Tech., Cambridge. Dept. of Civil Engineering.
S. A. Wells, and J. A. Gordon.
Water Resources Bulletin, Vol 18, No 4, p 661-670, August, 1982. 7 Fig, 7 Tab, 18 Ref. OWRT A-054-TENN.

Descriptors: *Reservoirs, *Water quality, *Model studies, Mathematical models, Water management, Water supply, Physical properties, *Tennessee, Center Hill Lake, Cherokee Lake.

An adequate basis for determining geometric assumptions in reservoir water quality models was sought. The influence of the lateral dimension on water quality parameters proved to be negligible. The most important parameters, temperature and dissolved oxygen, both showed little variation over the width of the study reservoirs - Center Hill Lake and Cherokee Lake. The statistical analysis of the data, using a comparison of standard deviations in each direction, resulted in the conclusion that lateral variations were not significant. Even from a theoretical standpoint, mixing processes were occurring at a rate faster than water quality change over the lateral dimension. Both vertical an longitudinal variations in dissolved oxygen would be expected. It was concluded that lateral variation in water quality is negligible. It was also determined that one-and two-dimensional water quality models will adequately predict reservoir water quality in most cases. (Baker-FRC)
W83-01481

FARMERS' ATTITUDES TOWARD GOVERNMENT INVOLVEMENT IN PREVENTING AGRICULTURAL NONPOINT SOURCE WATER POLLUTION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
F. D. Parent, and S. B. Lovejoy.
Water Resources Bulletin, Vol 18, No 4, p 593-597, August, 1982. 5 Tab, 12 Ref.

Descriptors: *Erosion control, *Conservation, *Farming, *Indiana, Financial aspects, Water pollution sources, Nonpoint pollution sources, Sedimentation, Pollution load.

At present agricultural lands are producing vast amounts of sediment, which is a primary cause of water pollution. However, if erosion control practices were more widely adopted, this problem could be lessened. Farmers on a small watershed in northeastern Indiana were interviewed before and after a major demonstration project focusing upon the control of erosion was performed. A majority of the farmers felt that those who adopt pollution control techniques should not pay their entire cost. Over 60% of the farmers also believed that the federal government should play an important role in soil conservation programs. However, fewer respondents were willing to use federal taxation to completely clean up the water resources. A majority of the respondents indicated that the individual landowner should be responsible for controlling the soil erosion problem. These findings suggest the farmers want assistance from the government, but feel that the individual landowners should retain the right to decide on the land use practices to be employed on their own farms. (Baker-FRC)
W83-01506

LABORATORY EXPERIMENTS AS AN AID TO LAKE RESTORATION DECISIONMAKING,
Southwest Florida Water Management District, Brooksville.
P. M. Dooris, V. Ley, and D. F. Martin.
Water Resources Bulletin, Vol 18, No 4, p 599-603, August, 1982. 1 Fig, 5 Tab, 13 Ref.

Descriptors: *Lake restoration, *Sedimentation, *Dredging, Drawdown, Sediment control, Decision making, Management, Rehabilitation, Lakes, Physical properties, Chemical properties, Water management, Lake management, Laboratory studies, *Florida, Sawgrass Lake.

Laboratory experiments are described which were used to evaluate the suitability of sediment from Sawgrass Lake for a drawdown/consolidation restoration procedure. The experiments as described could be applied to other lakes as an aid to decisionmaking in lake rehabilitation projects. Sawgrass Lake is located in Pinellas County on the outskirts of St. Petersburg, Florida. Laboratory experiments conducted included chemical analysis of sediment (water content, organic content, pesticides, nutrients), rate of sediment compaction studies and rehydration at ambient conditions, and the effect of treatment with alum and other chemicals. Several considerations indicated that drawdown was not a good choice for improving the condition of Sawgrass Lake. Chiefly these considerations centered on the composition of the peat or accumulated organic ooze overlying the hard bottom and the physical properties of the overlying organic material. Significant concentrations of chlordane and PCB were found in lake sediment with high concentrations of nitrogen, iron, zinc, and phosphorus. These data indicated the desirability of removing the sediments from the lake. Considering the problems of sediment composition and unfavorable properties, mechanical dredging of the lake was favored over drawdown for restoration. Storm water management problems also favored

dredging. This study emphasizes the need for the feasibility evaluation of potential lake rehabilitation methods prior to their being incorporated into a restoration plan. (Baker-FRC)
W83-01507

LOW FLOWS OF MASSACHUSETTS STREAMS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-01528

REDUCTION OF PH IN WATERS WITH HIGH TOTAL ALKALINITY AND LOW TOTAL HARDNESS,
Alabama Agricultural Experiment Station, Auburn.
B. K. Mandal, and C. E. Boyd.
Progressive Fish-Culturist, Vol 42, No 3, p 183-185, July, 1980. 1 Tab, 5 Ref.

Descriptors: *Fish conservation, *Alkalinity, *Hardness, *Hydrogen ion concentrations, *Gypsum, *Water quality control, Fishkills, Growth, Alum, Ammonium compounds, Calcium, Magnesium.

In some natural waters, calcium and magnesium concentrations are too low to precipitate carbonate ions, and pH levels may rise to above 10. When water from wells of the southeastern United States which experience high pH levels is added to fish ponds, poor growth or fishkills may result. The reduction of pH levels in fish ponds by the application of ammonium sulfate, filter alum or agricultural gypsum was studied in laboratory tests. Experimental pools treated with filter alum and ammonium sulfate showed little decrease in total alkalinity, while pools treated with agricultural gypsum showed a significant decline in total alkalinity. Total hardness also remained essentially unchanged except in pools treated with agricultural gypsum. Values for pH were usually about 1 unit lower for the gypsum-treated than for the control pools. By visual judgment, none of the treatments reduced phytoplankton growth. It was concluded that agricultural gypsum at about 2,000 milligrams/liter has no adverse effects on fish or other aquatic organisms and effectively lowers the pH of natural waters. (Geiger-FRC)
W83-01535

RELATIONSHIPS BETWEEN LAKE RESERVOIR MANAGEMENT AND AMBIENT NUTRIENT CONCENTRATIONS IN LAKE OKEECHOBEE, FLORIDA,
South Florida Water Management District, West Palm Beach.
A. C. Federico, and F. E. Davis.
Canadian Water Resources Journal, Vol 7, No 1, p 108-126, 1982. 7 Fig, 2 Tab, 9 Ref.

Descriptors: *Lake management, *Nutrients, *Water quality, Nitrogen, Phosphorus, Cycling nutrients, *Florida, Reservoirs, Lake Okeechobee, Littoral zone, Flood control, Water supply, Water resources development.

Lake Okeechobee is a eutrophic subtropical depression lake with a surface area of 1700 sq km and a mean depth of 2.6 m. A large littoral zone covers 25% of the surface area. To increase the lake's efficiency as a water supply and flood control reservoir, major modifications have been made to the lake and its drainage basins. At present the lake is completely surrounded by a large levee, and all but one of its 20 inflows and outflows are regulated by water control structures. Limnetic and tributary water quality data collected since 1973 were used to evaluate the response of the lake to nutrient load abatement measures and to a recent implementation of a higher water height regulation schedule. The higher regulation schedule was correlated with a significant increase in the limnetic P concentration of the lake. During this same period of time there was a significant shift from the maximum biomass yield being potentially limited by P to its being potentially limited by N, based upon inorganic N to P ratios. It is hypothesized that the increased ambient P levels resulted from internal P loadings caused by prolonged flooding of the extensive littoral zones and flooding of intensively farmed agricultural islands resulting from the higher regulation schedule. The increased P concentrations coupled with a reduction of the N loading through external nutrient loading abatement measures may be responsible for the significant decline in the lake's N to P ratio. (Baker-FRC)
W83-01550

USE OF PHOSPHORUS BUDGET MODELS IN RESERVOIR MANAGEMENT,
Waterloo Univ. (Ontario). Dept. of Biology.
H. C. Duthie, and M. L. Ostrofsky.
Canadian Water Resources Journal, Vol 7, No 1, p 337-348, 1982. 23 Ref.

Descriptors: *Reservoir operation, *Model studies, *Phosphorus, Nutrient requirements, Vegetation, Sedimentation, Sediments.

A concise summary of the limnological study performed at the Churchill Falls, Labrador hydroelectric scheme is offered, along with an introduction to phosphorus modeling and its use as a tool in water resources management. Problems relating to the application of phosphorus models under conditions peculiar to reservoirs are cited. The quality of phosphorus budgets is greatly influenced by several phenomena important in reservoirs, in particular the release of phosphorus from inundated soils and vegetation and from sediments following drawdown. Nevertheless, the pre-impoundment calculation of phosphorus budgets is feasible and provides a useful tool for reservoir management as well as in impact assessment studies. (Baker-FRC)
W83-01553

TRACE ELEMENT CHARACTERIZATION OF COAL WASTES - FIFTH ANNUAL PROGRESS REPORT,
Los Alamos Scientific Lab., NM.
R. C. Heaton, L. E. Wangen, P. L. Wanek, J. M. Williams, and E. F. Thode.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-010983, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-087, July 1982. Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina. 6 p, 2 Fig.

Descriptors: *Coal, *Trace elements, *Mine wastes, *Leachates, *Waste disposal, Lime, Limestone, Hydrogen ion concentration, Cost analysis, Calcination, Iron, Effluents.

The most promising control technology for dealing with high-sulfur coal wastes consists of sequential slurry coating of the waste with lime and limestone. In the configuration tested, this technique controlled the waste effluent quality for 4 months; the effluent pH remained between 7.3 and 7.6, and the trace element concentrations (Al, Ca, Mn, Fe, Co, Ni, Cu) were reduced by 40 to 99-plus %. Codisposal of coal wastes and alkaline soils or mine overburdens is partly effective in controlling the leachate quality under steady-state conditions. However, none of the materials tested could control the highly acidic effluents obtained under intermittent leaching conditions. Comparisons between trace element concentrations predicted by chemical equilibrium models and those obtained in experiments with coal waste leachates yielded good agreements for the major cations (Al, Ca, Fe) but, except for fluoride, the major anions were not well accounted for. The observed trace element concentrations were all significantly lower than predicted. Calcination experiments have shown that high-sulfur coal waste from Appalachia (Plant K) behaves differently than other wastes studied. The high cost of this technology ($1.39 to $9.84/ton product) places it outside the realm of economic feasibility at this time. Plant K coal wastes are similar to those from the Illinois Basin and their leachates are often very acidic, with pH values sometimes less than 2. Several trace elements have shown discharge severities greater than unity, but iron is by far the worst offender, with values sometimes greater than 100. (Moore-SRC)
W83-01558

ACCOMPANYING MEASURES PROVIDING A PERMANENT RESTORATION SUCCESS IN SHALLOW LAKES (FLANKIERENDE MASSNAHMEN ZUR SICHERUNG DES SANIERUNGSERFOLGES AN FLACHEN GEWASSERN),
Technische Univ. (Germany, F.R.) Inst. fuer Oekologie.
W. Ripl.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 131-135, June 1982, 1 Tab, 25 Ref.

Descriptors: *Lake restoration, *Cycling nutrients, *Sludge bank, *Dredging, *Oxidation, Shallow lakes, Sediments, Sweden, Berlin, Federal Republic of Germany, Phosphorus removal, Water quality control, Nitrates, Nittification, Denitrification, Oxidation, Oxygen balance.

In many lakes, especially shallow lakes, banks of sludge composed of decayed organisms form in the sediment, releasing pollutants into the lake so that even when all wastewater input is eliminated, little improvement in water quality occurs. In Lake Trummen in Sweden, sludge banks were being deposited at a rate of 8 mm/yr, and a macrophyte belt was spreading out from the shore, so that the lake was in danger of disappearing. The sludge bank was dredged out by vacuum, and the remaining original sediment caused water-quality improvement. Methods of eliminating such sludge in situ were then sought; in Lake Jarla and the Wahnbach reservoir, compressed air was introduced in the hope of oxidizing the sludge and thereby eliminating its negative effects. The method was successful in improving oxygen balance in the hypolimnion and influencing degradation of newly produced organic substances, but unsuccessful in instituting aerobic processes in the sludge, so that nutrient recirculation continued. Destratification can be successful in shallow lakes with little hypolimnion. Further experiments were undertaken in Lakes Lan and Lot in Sweden and in the Reithensee in Austria to precipitate phosphate in the water and to bind it to sediment. Only in Reithensee was a lasting effect seen, perhaps due to use of iron chloride rather than aluminum sulfate as the precipation medium. Nitrification/denitrification studies resulted in the experimental injection of nitrate into the sediment of Lake Lille in Sweden, a highly hypertrophic lake with a low oxygen supply. The procedure reduced oxygen consumption to one-quarter and phosphorus and nitrogen release to one-sixth of the original. Before these measures are performed, knowledge of sediment properties and function is necessary. A table is given whereby costs for the various measures can be estimated. (Gish-FRC)
W83-01584

MEASURES TO CONTROL EUTROPHICATION IN SWISS MIDLAND LAKES (EUTROPHIERUNGSKONTROLLMASSNAHMEN AN SCHWEIZER MITTELLANDSEEN),
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung and Gewaesserschutz, Zurich (Switzerland).
H. Ambuhl.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 113-120, June 1982, 6 Fig, 3 Tab, 7 Ref.

Descriptors: *Eutrophic lakes, *Lake restoration, *Phosphorus removal, *Wastewater treatment, *Switzerland, Fertilizers, Aeration, Hypolimnion, Oxygen depletion, Model studies, Destratification, Filtration.

With few exceptions, the lakes of the Swiss midland region are overfertilized with phosphorus (P). Neither production (biomass synthesis, carbon assimilation) nor its consequences fulfill the legal requirements. The annual production of all the midland lakes is higher than the optimal mesotrophic value of 150 g C/yr. Long-term observations have shown that P concentrations increased continually into the 1970s. This trend still continues in

lakes with low P concentrations. Some P-rich lakes show decreases. The hypolimnetic oxygen content is mostly depleted, often down to zero. Theoretically there is often a high oxygen deficit value. Most of the lakes are incompletely mixed due to insufficient wind exposure. Most of the sewage-treatment plants in the catchment areas of the lakes are equipped with P-elimination systems. The maximum P content of 1 mg/l in purified sewage as allowed by law is adhered to in most cases, but further measures are necessary: input of the purified sewage below the productive layer of the lake; prevention of over-fertilization and enforcement of proper use of fertilizers in agricultural areas to prevent leaching; further improvement of the precipitation-fertilization technique in sewage plants. In certain cases these measures are inadequate, so intervention in intralake fertilizin processes is necessary: draining off of P-rich hypolimnetic water; improvement of inadequate natural turnover by means of artificial energy input; and increase of reduction/oxidation potential in the hypolimnion by artificial aeration with air or pure oxygen. The necessary strategies were worked out for three lakes (Hallwilersee, Baldeggersee, Sempachersee) by means of a dynamic lake model, and two of the required measures (oxygen aeration and destratification in winter) are already being applied.
W83-01585

THOUGHTS ON USING THE RESULTS OF THE OECD-MONITORING PROGRAM IN LAKE PROTECTION (GEDANKEN ZUR UBERTRAGUNG DER ERGEBNISSE DES OECD-UNTERSUCHUNGS-PROGRAMMES IN DIE PRAXIS DES SEENSCHUTZES),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, and J. Clasen.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 96-103, June, 1982. 4 Fig, 4 Tab, 31 Ref. English summary.

Descriptors: *Reservoirs, *Trophic level, *Water use, *Lake restoration, Chlorophyll, Chlorophyll a, Phosphorus, Euphotic zone, Limnology, Lakes, Wahnbach reservoir, *Federal Republic of Germany, Algal growth, Drinking water, Lake classification.

The possibilities and limitations of application of the results of the OECD investigation to the restoration of lakes and reservoirs are discussed, with the emphasis on reservoirs. The trophic states classified by the OECD program must be applied to desired water utilization to be useful: e.g., reservoirs used for drinking water should ideally be oligotrophic, though mesotrophy is tolerable. Trophic states are defined in terms of total phosphorus (P) and nitrogen, chlorophyll a content, and Secchi transparency, and the categories overlap. As water use depends largely on algal development, maximal chlorophyll concentrations during growth periods (peak value of chlorophyll a) rather than average chlorophyll concentration in the euphotic zone should be used as criteria. It is not possible simply to transplate OECD chlorophyll concentrations into type and content of phytoplankton and to ensuing water-treatment problems. For example, algal regeneration can occur in drinking water with algal-originating organic-substance contents of > 1 mg/l (> 1.5 mg/l in raw water). Examples occurring in the Wahnbach reservoir (Federal Republic of Germany) illustrate this point. When estimating the tolerable P level, consideration must be given to category overlap, e.g., the 25 microg/l total P required to achieve mesotrophy has only a 15% probability of resulting in eutrophy. Algae with a low P requirement can produce high chlorophyll levels even with P limitation, while high zooplankton volume can cause lower than expected chlorophyll levels (grazing effect) with a given P level. Total P is superior to orthophosphate as a criterion. The morphology of the lake must also be considered; e.g., P is continually released from sediment in shallow lakes with nutrient-rich sediment. The tolerable allochthonous P load can be calculated from the tolerable total P as an average annual value, and diagrams to illustrate two equations developed to calculate this value are given. (Gish-FRC)
W83-01599

THE ROLE OF AQUATIC WEEDS IN MAINTAINING SURFACE WATER QUALITY,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
A. A. de la Cruz, and J. D. Yarbrough.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150094, Price codes: A04 in paper copy, A01 in microfiche. WRRI Publication, September 1982, 53 p, 30 Tab, 3 Fig, 14 Ref. OWRT A-134-MS(1), 14-34-0001-2126.

Descriptors: Ponds, Lakes, *Insecticides, *Wastes assimilation, Water quality, Biological accumulation, Mississippi, *Aquatic weeds, *Endrin, *DDT, *Radioactivity.

Three common aquatic weeds (Lemna purpocilla, Ceratophyllum demersum, and Ludwigia palustris) were exposed to radioactively labelled insecticides. These weeds readily assimilated the radio-insecticide within the first few hours of exposure, and up to about 20 ug/g after 96 hours. Bioconcentration of DDT-14C, Endrin-14C, and DDT-3H was greater for Ceratophyllum than for Lemna and Ludwigia. Exposure to Endrin and DDT simultaneously or in series did not reveal any inhibition by, selection for, or stimulation due to one or the other insecticide. Microcosms containing water, sediment, and plants partitioned the insecticides either in decreasing order for the water or increasing order for sediment and plants. Aquatic weeds introduced in tanks containing contaminated sediment and reflooded with clean water were detected positive for radio-insecticide. Presence of very low level radioactivity in the clean medium holding labelled plants for as long as four days indicated only physical extraction of radio-insecticide adhering to plants' external surfaces and not active bioelimination from internal tissues. This ability of aquatic weeds to bioaccumulate radio-insecticide, concentrate it from extremely low level leacheates, and hold it in their tissues is evidence of their value in cleaning surface waters of unwanted chemicals.
W83-01601

AN ASSESSMENT OF THE PERFORMANCE OF FEDERALLY REGULATED SEDIMENTATION PONDS,
Arizona Univ., Tucson. School of Renewable Natural Resources.
W. B. Vandivere.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150185, Price codes: A08 in paper copy, A01 in microfiche. M.S. Thesis, 1980. 150 p, 7 Fig, 10 Tab, 55 Ref, 4 Append. OWRT- B-073-ARIZ(6), 14-34-001-9056.

Descriptors: *Sedimentation basins, *Strip mines, *Rainfall intensity, *Sediment control, *Computer models, Coal mines, Land reclamation, Hydrologic models, Semiarid lands, Surface water, Water pollution control, Regulations.

In the semi-arid regions of the western U.S., extreme variability in the occurrence and nature of precipitation introduces an element of uncertainty into the design process for sedimentation ponds used in conjunction with surface mining operations. A hypothetical watershed with characteristics common to the study area funtioned as the medium for surface water flux to the detention facility. Pond design was based on accepted hydrologic and engineering procedure and concurred with published federal reclamation statutes. Computer programs were utilized to model both the temporal characteristics of south western convective rainfall and the generation of water and sediment inflows resulting from the application of storms over the watershed. A previously developed sedimentation routine was then used to determine effluent sediment concentrations corresponding to the modeled events. Three watershed-pond conditions were investigated to assess the efficacy of the sedimentation pond in meeting effluent quality standards. Results indicated that poor pond performance ensued unless chemical treatment was maintained. Since variations in precipitation intensity influenced predicted pond performance, it was recommended that hydrologic uncertainty be considered in the drafting of regional reclamation states. (Moore-SRC)
W83-01610

OXYGEN TRANSFER CALCULATIONS FOR A TRACTOR-POWERED PADDLEWHEEL AERATOR,
Auburn Univ., AL.
M. S. Armstrong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150250, Price codes: A03 in paper copy, A01 in microfiche. M. S. Thesis, March 18, 1982, 35 p, 8 Fig, 1 Tab, 23 Ref. OWRT B-076-ALA(12).

Descriptors: *Oxygen transfer, *Aerators, *Catfish farming, Aeration, Fish farming, Aquaculture, Dissolved oxygen, Spraying.

The economic success of commercial channel catfish production requires high stocking densities and feeding rates. At feeding rates of 45 kg/hectare per day and greater, emergency aeration is occasionally required to prevent fish kills during periods of low dissolved oxygen. Paddlewheel aerators powered by farm tractors are widely used by catfish farmers. Standard aeration tests were conducted to establish oxygen transfer coefficients and rates for a paddlewheel aerator operated at different speeds and paddle depths. The greatest oxygen transfer rate (35.1 kg of oxygen/hr) were obtained at 108 rpm and 54 cm paddle depth. All trials at 108 or 128 rpm with paddle depths of 36 cm or more had oxygen transfer coefficients and rates greater than 20/hr and 20 kg oxygen/hr, respectively. There was good agreement between the size and shape of spray patterns, and oxygen transfer coefficients and rates. This suggests that for practical purposes the paddle depth and rotation speed for optimal oxygenation may be estimated from the spray pattern; the greater the amount of spray, the more aeration. (Moore-SRC)
W83-01619

A DECADE OF DEBATE: AIR AND WATER,
For primary bibliographic entry see Field 5B.
W83-01668

CHEMICAL SPILL CLEANUP NAMED PROJECT OF THE YEAR.
Civil Engineering - ASCE, Vol 52, No 9, p 40-42, September, 1982. 3 Fig, 1 Tab.

Descriptors: *Groundwater contamination, *Organic compounds, *Accidents, Hazards, Safety, Percolation, Cleanup, Temperture effects, Spray irrigation, Marshes, Environmental effects, Water pollution sources, *Michigan.

Potential groundwater contamination problems existed when a freight train derailed near Woodland Park in Michigan. Four tank cars carrying chemicals - vinylidene chloride, phenol, and ethylene oxide - were damaged. The latter chemical evaporated, posing no threat to groundwater. The phenol froze due to the cold and was removed primarily with excavated earth. Vitually all of the 300,000 lb of vinylidene chloride that spilled percolated through the soils into the groundwater. About 70,000 lb of phenol remained in the soil, as was determined later. Vinylidene chloride, having spread over 17 acres, was approaching several private wells and nearby East Lake. In treatment phase I groundwater was pumped to the surface from nine pruge wells. Phase II called for the installation of a spray-irrigation system in a marsh area beside East Lake. Effluent from the aeration ponds was irrigated continuously at 800 to 1,000 gpm. Test confirmed that irrigation reduced the vinylidene chloride to a non-detectable concentration. (Baker-FRC)
W83-01671

CO-OPERATION CLEANS UP THE MANAWATU,
K. Currie.
Soil and Water, Vol 16, No 4, p 5-8, August, 1980. 4 Fig.

Descriptors: *Rivers, *Water quality, *Water pollution control, Industrial wastes, Wastewater disposal, Biochemical oxgyen demand, Flow regulators, Flow rates, Deoxygenation, *New Zealand, Manawatu River.

The Manawatu River (New Zealand) drains a catchment of 5800 sq km, is an extensively branched catchment, and experienced a major fish-kill in January of 1978. Five installations discharge waste into the river over a 5.8 km reach downstream of Palmerston North. These five include Palmerston North City Corporation (domestic sewage and trade wastes), Linton Military Camp (domestic sewage), Manawatu Co-operative Dairy Company Limited, NZ Pharmaceuticals Limited, and Borthwicks/CWS Limited (slaughterhouse and meat processing wastes). The total peak load on the river is 23,500 kg/day of BOD, equivalent to the raw sewage of a population of over 300,000 people. Attempts were made successfully to gather all interested parties and take steps to improve the conditions on the river. It was determined that acceptable conditions would result if the daily mean BOD concentration of the river did not exceed 5 g/cu m (to limit sewage fungus) and the BOD concentration did not exceed 5 g/cu m at any time during the hours of darkness (to prevent deoxygenation). To achieve these ends flow was regulated, mixing zones were established and effluent load was apportioned. Water quality can now be maintained at minimum cost to the dischargers and ultimately to the community. (Baker-FRC)
W83-01687

RIVER OF NO RETURN,
G. Ashfield.
Feedlot Management, Vol 23, No 4, p 12-14, April, 1981. 1 Fig.

Descriptors: *Waste management, *Feedlots, *Animal wastes, Effluents, Drainage, Rainfall, Runoff, Dikes, Rivers, Water pollution control, *Minnesota, Cottonwood River.

A dike system was constructed which effectively and inexpensively checks effluent from a feedlot which might have otherwise mingled with clear running water in the Cottonwood River, Minnesota. Manure handling for the 1,000 fed cattle marketed yearly from the farm entails separating liquid from solid and spreading the solid on the land. The feedlot consists of two dirt based lots with a feedbunk running part-way between. Controlling liquid effluent begins by limiting the amount of water that mingles with the manure. Groundwater reaching the lot is limited. Rainwater from the building is directed underground to a drainage system that bypasses the feedlot and diking system. Solids in the feedlot are collected and spread as fertilizer every few weeks or as weather permits. (Baker-FRC)
W83-01699

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, J. Schreiner, and G. D. Hopkins.
In: Wastewater Reuse for Groundwater Recharge, Proceedings of the Symposium held on September 6-7, 1979 at California State Polytechnic University at Pomona. California State Water Resources Control Board, Office of Water Recycling, Sacramento, May 1980, p 283-316, 13 Fig, 8 Tab, 13 Ref.

Descriptors: Water quality, *Groundwater recharge, *Water quality management, *Pollutants, *Water sampling, Adsorption, Organic compounds, Chemical oxygen demand, Biodegradation, Water reuse, Reclaimed water, Injection wells, Observation wells, Monitoring, Concentration time.

Water quality data are presented from a field study in which reclaimed water was injected directly at a rate of 6 liters per second into an aquifer in the Palo Alto Baylands. The program's aim was to rehabilitate a saline aquifer, to prevent salt water intrusion from San Francisco Bay, and to evaluate the long term potential for augmenting the potable water supply. Six observation wells, at distances of 10 to 40 m from the injection site, monitored water quality changes. The behavior of trace organic contaminants was of particular concern and was studied by observing concentration changes at the observation wells following injection. Determination of specific organic compounds was made by gas chromatography. The concentrations of trace organics in the injected water fluctuated widely due to operational changes at the reclamation facility; however, the data on these pollutants show evidence of retardation of movement, presumably caused by adsorptive interaction with the aquifer. Trihalomethane compounds show evidence of biodegration in the aquifer. The concentration of total organic substance as measured by total organic carbon and chemical oxygen demand is decreased significantly by biodegradation, but total organic halogen appears unaffected by aquifer passage. The organic pollutants remaining after water reclamation treatment can be health threatening if the water is intended for potable reuse. Recharge by direct injection attenuates the risk via adsorption and degradation and by smoothing concentration fluctuations. Sorption and biodegradation can also mitigate the risks associated with pollution from sources other than injection, i.e., spills, landfills. (Atkins-Omniplan)
W83-01708

'SECOND BEST' EFFLUENT FEES IN WATER QUALITY MANAGEMENT: PROBLEMS OF ACHIEVING EFFICIENCY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6C.
W83-01744

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

SIMULATED EFFECTS OF GROUND-WATER DEVELOPMENT ON THE POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
W. E. Wilson, and J. M. Gerhart.
Available from Supt. of Doc., GPO Washington, DC 20402. Price $5.50. Geological Survey Professional Paper 1217, 1982. 83 p, 41 Fig, 9 Tab, 44 Ref, Append.

Descriptors: *Model studies, *Groundwater, *Potentiometric level, Aquifer characteristics, Water level fluctuations, Selective withdrawal, Water table, Projections, Water use, Irrigation, Municipal water, Phosphates, Geohydrology, Computer models, *Florida, West-central Florida, *Floridan aquifer.

A digital model of two-dimensional ground-water flow was used to predict changes in the potentiometric surface of the Floridan aquifer, 1976 to 2000, in a 5,938-square-mile area of west-central Florida. In 1975, ground water withdrawn from the Floridan aquifer for irrigation, phosphate mines, other industries, and municipal supplies averaged about 649 million gallons per day. Rates are projected to increase to about 840 million gallons per day by 2000. The model was calibrated under steady-state and transient conditions. Input parameters included transmissivity and storage coefficient of the Floridan aquifer; thickness, vertical hydraulic conductivity, and storage coefficient of the upper confining bed; altitudes of the water table and potentiometric surface; and ground-water withdrawals. Simulation of May 1976 to May 2000, using projected combined pumping rates for municipal supplies, irrigation, and industry (including existing and proposed phosphate mines), resulted in a rise in the potentiometric surface of about 10 feet in Polk County, and a decline of about 35 feet in parts of Manatee and Hardee Counties. The lowest predicted potentiometric level was about 30 feet below sea level. Predicted declines for November 1976 to October 2000 were generally 5 to 10 feet less than those for May 1976 to May 2000. (USGS)
W83-01401

DETERMINATION OF SENSITIVITY OF WATER QUALITY PARAMETERS FOR STREAM POLLUTION CONTROL,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5G.
W83-01413

WELFARE COST OF EUTROPHICATION-CAUSED PRODUCTION LOSSES: A CASE OF AQUACULTURE IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Kitabatake.
Journal of Environmental Economics and Management, Vol 9, No 3, p 199-212, 1982. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Eutrophication, *Lakes, *Aquaculture, Economic aspects, Water resources development, Lake Kasumigaura, Model studies, Productivity, Environmental effects, *Japan, Ecosystems.

Production functions and eutrophication-caused damage functions for aquaculture are estimated in Lake Kasumigaura. The equations are used to calculate, given the price data of 1978, the welfare cost of production losses from the eutrophication of Lake Kasumigaura under the assumption of horizontal demand curve. In spite of the lack of reliable information on water quality levels in culture grounds as well as on dose-response relationships for cultured carp, physical damage functions are estimated for two types of culture operators, i.e., operators with feed supply boxes and those feeding with their hands, where the damage data were collected through the survey questionnaire. The estimation indicates that the operators feeding with their hands are not affected by the eutrophication of the lake. On the other hand, for operators equipped with feed supply boxes the physical damage rate per output quantity is estimated to be negatively related to Secchi depth, which is an indicator of eutrophic status of the lake. The paper demonstrates that the welfare cost calculation for the aquaculture industry in Lake Kasumigaura is affected by two factors, that are the measures taken by operators to prevent the production losses and whether or not the industry is competitively organized. (Baker-FRC)
W83-01435

A NEW LOOK AT OPTIMAL ALLOCATION OF WATER RESOURCES,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kindler.
Nature and Resources, Vol 18, No 1, p 10-14, March, 1982.

Descriptors: *Water allocation, *Decision making, *Multiobjective planning, *Optimization, Alternative planning, Economic efficiency, Social aspects, Systems analysis, Water demand, *Model studies.

A model for decision making incorporates human value judgments, conflicting interests, and other considerations as well as economic factors to choose an optimum solution for water allocation. Selecting economic efficiency as the only objective as rarely sufficient, especially in rapidly developing countries. This procedure often produces a large number of solutions within a small range of cost efficiencies but with large variability in social or institutional effects. Other objectives which are important in multiobjective analysis of allocation schemes are environmental quality, distributional effects, regional growth and stability, national self-reliance, and risk considerations. The priorities among these objectives depend on a society's needs, with great possible differences between industrialized and poor societies and among communities. A multiplicity of objectives also leads to conflicts. The model is illustrated using the Kavlinge River basin, in which water required for irrigation and a municipal water supply is obtained from a regulated lake and the river. In this case the seven objectives are to maximize crop yield from three fields, minimize water deficit in the city, and maintain the optimum flow at the control point, the optimum lake level for recreation, and an acceptable pollutant level. (Cassar-FRC)
W83-01484

DRAFT STAFF REPORT FOR FACT-FINDING HEARING ZAYANTE CREEK/LOWER SAN LORENZO RIVER AND THE UPPER SAN LORENZO RIVER INSTREAM BENEFICIAL USE PROTECTION PROGRAM.
California State Water Resources Control Board, Sacramento.
September 1982. 127 p, 11 Fig, 21 Tab, 59 Ref, 11 Append.

Descriptors: *Streams, *Rivers, *Beneficial use, Public hearings. *Water quality management, Cost analysis, Water quality, Water supply, Fisheries, Recreational demand, Erosion control, Habitats, Streamflow, Sediment transport, Sediment control, *California, San Lorenzo River, Zayante Creek.

The State Water Resources control Board (SWRCB) reviews water right applications and issues appropriation permits to best protect the public interest and lessen adverse environmental impacts. This report presents a recommended instream beneficial use program for Zayante Creek/ San Lorenzo River, alternatives to the program and background data on the system's water-related resources. Water development and land use are limiting some instream uses, which include swimming, fishing, camping, rafting, hunting and esthetic enjoyment. Of the offstream uses, the San Lorenzo provides water for over one-third of Santa Clara County. The most critical problems related to instream needs are: flow depletion for fish; bedload sediment; flow transport of bedload sediment; and bacterial contamination affecting public health. Alternatives were developed to allow analysis of potential SWRCB actions to resolve each of these problems separately. Alternative 1 is a no-action plan and allows for a comparison of alternatives. Alternative 2 would determine if instream uses could be maintained/restored if the Board prevented new diversions which would reduce the stream's ability to transport sediment and reduce fish habitat. Alternative 3 addresses flows necessary to transport sediment and assures that erosion and sediment input are controlled. Alternative 4 discusses recreational benefits that would occur with reduced fecal coliform bacteria levels that result from inadequate individual septic systems; sediment reduction actions are not part of this plan. The recommended program includes the objectives of alternatives 3 and 4, to be implemented via the proposed actions of alternatives 2, 3 and 4. (Atkins-Omniplan)
W83-01527

AN APPROACH TO SOLVING A BASIN-WIDE WATER RESOURCES MANAGEMENT PLANNING PROBLEM WITH MULTIPLE OBJECTIVES,
California Univ., Los Angeles. Dept. of Engineering Systems.
P. W. F. Louie, W. W-G. Yeh, and N-S. Hsu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150052, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Contribution No 184, September 1982, 32 p, 13 Fig, 6 Tab. OWRT A-077-CAL(3).

Descriptors: *Multiobjective Planning, *Water Management, *Groundwater Basins, *Optimization, Resources Management, Water Quality, Water Supply, Wastewater, Conjunctive Use, Simulation Analysis, Model Studies, *Water allocation, *Water pollution control, *Linear Programming.

A multiobjective optimization procedure using the Contraint Linear Programming technique has been developed to assist water resources planners in their effort to establish a more unified basin-wide management plan--a plan which will simultaneously consider the three major aspects in a basin-wide planning, namely, water supply allocation, water quality control, and prevention of undesirable overdraft of the groundwater basin. This optimization procedure is designed to be applied in concert with a groundwater quantity-and-quality model and/or a river flow-and-mass transport model, and a model which routes the water from the supply sources to various demand points, through the wastewater collection and treatment facilities, and ultimately to the disposal sites. The purposes is to attain a set of non-inferior management plans which fully consider all the interdependent elements represented by the simulation models. The influence Coefficient method is used as the connecting agent. The outputs of this optimization procedure are the quantities of water supply allocation from a given set of supply sources to various water use groups in the basin, the quantities transported from the users to the wastewater treatment plants, and from the facilities to the disposal sites. (Snyder-California)
W83-01574

PROCEEDINGS OF THE NATIONAL WORKSHOP ON RESERVOIR SYSTEMS OPERATIONS.
August 13-17, 1979, Boulder, Colorado; G. H. Toebes and A. A. Shephard, Eds, American Society of Civil Engineers, New York, New York, 1981. 601 p, 138 Fig, 25 Tab, 223 Ref. OWRT C-80354-T(No 8708)(1).

Descriptors: *Technology transfer, *Reservoir systems, *Reservoir operations, *Systems analysis, Education, Simulation, Optimization.

Objectives of the workshop included enhancement of technology transfer through the establishment of two-way lines of communication between users and researchers during the proceedings and formulation of specific recommendations to ensure continuation of this effort. The 90 participants represented federal agencies and private organizations engaged in reservoir systems operation and academic institutions involved in systems analysis research pertaining to this field. Among the major issues addressed were; the communications gap between practitioners and academicians; the form, content, and availability of literature from both sectors; the curriculum and methods of present educational offerings; and the validity of distinctions between simulation and optimization. To generate a permanent increase in the rate of technology transfer and maintain the cooperative interactions fostered by the workshop, the following set of recommendations were proposed: establish a steering committee on technology transfer; conduct a similar workshop in about 5 years to review progress; offer short courses directed toward particular systems; place researchers in working situations with mission oriented agencies; consider the Office of Water Research and Technology as a possible resource in advancing new ideas for technology transfer; and initiate a newsletter containing brief descriptions of successful systems analysis applications. (Moore-SRC)
W83-01635

6B. Evaluation Process

A REGIONAL APPROACH TO ESTIMATING RECREATION BENEFITS OF IMPROVED WATER QUALITY,
Los Alamos National Lab., NM.
R. J. Sutherland.
Journal of Environmental Economics and Management, Vol 9, No 3, p 229-247, 1982. 1 fig, 3 Tab, 39 Ref.

Descriptors: *Water demand, *Estimating equations, *Financial aspects, Water quality, Recreation, Fishing, Swimming, Benefits, Cost-benefit analysis, Populations.

A model has been presented that can be used to estimate recreation benefits for four water-based activities within a three-state region. Benefits can be estimated for any single site or for several sites simultaneously. Benefits can also be estimated for preserving existing water quality as well as improving degraded water. The major conclusion is that in Washington, Idaho and Oregon, the largest potential recreation benefits exist near the population centers. In contrast, improving water quality in sparsely populated areas will probably not stimulate a substantial increase in recreation demand. The findings may in some ways appear discouraging in terms of the economic variability of meeting the national goal of fishable and swimmable water. However, certain nonrecreation benefits such as property values, aesthetic values, option demand, and perhaps drinking water and health benefits are likely to display the same geographic pattern as recreation benefits. (Baker-FRC)
W83-01436

DESIGN FREEBOARD AND ECONOMIC EFFICIENCY,
Army Corps of Engineers, Baltimore, MD.
C. E. Yoe.
Water Resources Bulletin, Vol 18, No 4, p 643-648, August, 1982. 1 Fig, 2 Tab, 4 Ref.

The Corps treatment of design freeboard in local protection (LFP) studies is examined, and it is demonstrated that this is not consistent with economic efficiency criteria and thus not consistent with the Water Resources Council's National Economic Development planning objective. Some arguments as to why this is the case are analyzed, and a more economically efficient treatment of design freeboard is recommended. Design freeboard is an increment of height added to a dam, floodwall, levee, or channel, above and beyond the design flood height, intended to serve as a safety factor to account for unforseen errors in design. A study of current policies of the Corps of Engineers as applied in the Wyoming Valley, Pennsylvania, reveals that a $200 million project which is considered economically justified under policies now in effect is in fact not justified under strict economic efficiency criteria. It is suggested that the objective of economic efficiency can be better served by computing the real economic benefits and costs from the top of the existing LFP system to the top of the new LFP system. Freeboard must be dealt with in an interdisciplinary context to resolve the problems. (Baker-FRC)
W83-01476

MODEL TO EVALUATE CONSERVATION, DESIGN, AND ECONOMIC FEASIBILITY OF SUPPLEMENTAL IRRIGATION SYSTEMS IN THE SUB-HUMID REGION,
Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W83-01614

WATER RESOURCES MANAGEMENT SCHEME IN THE SOUTH COTENTIN (UN SCHEMA D'AMENAGEMENT DES RESSOURCES EN EAU LE SUD DE LA PRESQU'ILE DU CONTENTIN),
P. Tachoires.
Aqua, No 4, p 445-447, 1982. 2 Fig, 2 Tab.

Descriptors: *Project planning, *Investments, *Long-term planning, *Water deficit, *Economic evaluation, *Evaluation, Benefits, Projections, Planning, Economic aspects, Water costs, Water shortage, Drought, Capital costs, *France.

In 1976, droughts on the southern part of the Cotentin peninsula spurred administrative officials to plan for the avoidance of water deficiencies with investments up to the year 2000. SAFEGE was called upon to help define program goals in a three part study. In the first stage, consulting engineers collected hydrologic data projecting water needs to characterize the investments to be programmed. Sixteen investment programs which would eliminate water deficiencies were defined. By combining the best programs, three new plans were formulated which could be more closely studied and compared. The final choice of a progam was based on the discounted cost, the spacing of important investments, and the problems which would be generated by programmed investments. Consultation between the consulting engineers and administrative officials helped to establish a plan which met the lowest cost constraints. (Geiger-FRC)
W83-01648

WEIGHING THE WASTEWATER OPTIONS,
For primary bibliographic entry see Field 5D.
W83-01658

RELIABILITY PROGRAMING IN RESERVOIR MANAGEMENT. 3. SYSTEM OF MULTIPURPOSE RESERVOIRS,
Institut za Vodioprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 4A.
W83-01735

AN APPROACH TO RISK AND UNCERTAINTY IN BENEFIT-COST ANALYSIS OF WATER RESOURCES PROJECTS,
George Washington Univ., Washington, DC. School of Engineering and Applied Sciences.
A. Goicoechea, M. R. Krouse, and L. G. Antle.
Water Resources Research, Vol 18, No 4, p 791-799, August, 1982. 8 Fig, 1 Tab, 12 Ref. 12 Ref.

Descriptors: *Cost-benefit analysis, *Risks, *Alterntive planning, Benefits, Water resources development, Planning, Probability distribution, Flood control, Decision making, Halstead, Flood Protection Project, Uncertainty, *Little Arkansas River basin.

A methodology for incorporating risk and uncertainty in benefit-cost (B/C) analyses produces a distribution of the B/C ratio. The model reflects the fact that benefits and costs usually vary over a range of values. The procedure was applied to the single-purpose Halstead Flood Protection Project in the Little Arkansas River Basin. Optimistic, expected, and pessimistic values were estimated for all cost components (interest and amorization, operations and maintenance) and all benefit components (inundation reduction, location, affluence, saving in floodproofing costs, employment, and recreation) producing B/C ratios from 10.04 to 2.62, with 1.63 the expected or medium ratio. The distribution indicated that 48% of the time the B/C ratio would be less than or equal to 1.63. This method can help decision makers in several ways. If two alternative plans have the same expected B/C ratio and different variances, the one with the samller variance is clearly preferable. If two alterntive plans have different expected B/C ratios and equal variances, the one with the larger expected B/C ratio is preferable. Several limitations are apparent. It is difficult to evaluate a group of alternates with different B/C expected values and variances. B.C is not the only criterion for project evaluation; national economic development, environmental quality, and other needs must be considered. The process of arriving at ranges for benefits and costs is subjective and therfore variable among different planners. The procedure applies only to situations involving gamma random variables only or normal random variables only, whereas real situations often involve a mixture of random variables. (Cassar-FRC)
W83-01745

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ANALYSIS OF ALTERNATIVES FOR COST SHARING WATER RESOURCES PROJECTS AND PROGRAMS,
Georgia Univ., Athens. Inst. of Natural Resources.
R. M. North, and J. Sellers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150177, Price codes: A05 in paper copy, A01 in microfiche. Georgia Institute of Technology Environmental Resources Center Report ERC 07-82, August 1982. Atlanta. 93 p, 4 Fig, 26 Tab, 22 Ref. OWRT B-142-GA(1), 14-34-0001-9065.

Descriptors: *Cost sharing, *Water resources development, *Financing, *Flood control, Georgia, Taxes, Economic aspects, User charges, Political aspects, Flood damage.

Historical aspects of Federal/non-federal sharing of water resources costs were reviewed for projects and programs. The theoretical basis for these sharing arrangements were explored and the authors suggest that the only theoretically sustainable purpose for cost sharing is that of effecting changes in economic distribution or equity - not efficiency. The alternative cost sharing policies proposed in 1975, 1976, 1977 and 1978 were described and evaluated with respect to anticipated changes in shares of cost burdens should certain options be adopted. These evaluations were done in detail for flood damage reduction in the south Atlantic Gulf region. General estimates of cost sharing in Georgia were developed from available State budget data. All cost sharing and financing proposals emanating from Federal and state sources, in common, support or accede to a decreasing Federal financial and cost burden offset by increasing state assumption of both financing and cost burdens - some of which would be recovered from beneficiaries through user charges.
W83-01609

THE EVALUATION OF SELECTED FREEZE DESALTING PILOT PLANTS FOR SUITABILITY AND POTENTIAL INTEREST FOR FURTHER COMMERCIAL DEVELOPMENT,
Burns and Roe Industrial Services Corp., Oradell, NJ.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150334, Price codes: A06 in paper copy, A01 in microfiche. Report, October 18, 1982, 104 p, 13 Fig, 16 Tab, 33 Ref, 4 Append. OWRT C-10140-D(No 1467)(1), 14-34-0001-1467.

Descriptors: *Desalination plants, *Cost analysis, *Freeze desalination, *Water treatment, Pilot plants, Operating costs, Industrial development.

Because of the current phase out of all major OWRT activities, the need was felt to find private sector candidates that would be willing to acquire and continue to operate the four freeze pilot plants currently operated under OWRT auspices. The four units involved are: 25,000 gpd AFVC plant at Wrightsville Beach, NC; 6,000 gpd Falling Film plant at ABI, Oak Brook, IL; 2500 gpd Eutectic Freezing plant at Roswell, NM; and 500 gpd Secondary Refrigerant unit at Wrightsville Beach, NC. Order-of-magnitude cost estimates were prepared for the costs of modifying the units currently in operation and the costs involved in relocating the units from their present location to the facilities of a potential new private sector owner. In addition, major operating cost factors were identified for each unit. Potential applications for the freezing process were established based on staff experience and a limited literature search. A matrix was prepared establishing the suitability of each of the four freezing pilot plants for the major applications of the freezing process. A list was compiled of companies, institutions, and universities that might be interested in one of the freeze pilot plants. From the 49 contacts by phone, 35 expressed interest in obtaining more information for a further evaluation. The final result was that three expressions of interest were received for taking over one of the pilot units from OWRT. All three requests meet the criteria that were established for a possible transfer to these units to the private sector. (Moore-SRC)
W83-01629

RELATIONSHIP OF COSTS AND WATER USE EFFICIENCY FOR IRRIGATION PROJECTS IN IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 3F.
W83-01637

THE FINANCIAL IMPACT OF WATER RATE CHANGES,
California Univ., Los Angeles. Dept. of Geography.
W. H. Sang.
Journal of the American Water Works Association, Vol 74, No 9, p 466-469, September, 1982. 2 Tab, 15 Ref.

Descriptors: *Water rates, *Elasticity of demand, *Operating costs, Water demand, Income, Costs, Economic aspects, Pricing, Water use, Water consumption, Metropolitan Water District of Southern California, *California.

Increasing water rates to encourage water conservation often reveals a less-than anticipated elasticity of demand. Conversely, increasing water rates to improve revenues can show a greater-than anticipated elasticity of demand. Increased prices reduce water demand as much as 40-50% in some regions. This reduction in water demand has two major effects: total costs of water production and water revenues both decrease. Problems occur when total cost reductions are not in proportion to total revenue reductions. Although variable costs respond proportionately to total cost reductions, fixed costs do not, except possibly in increments on a long-term basis. Since most water utilities have large fixed costs, total costs may not decline enough to produce the desired result of increased net revenue. The experiences of the Metropolitan Water District of Southern California are used as an illustration. Projections of water rates, water demand, revenues, and costs for 1981-2000 showed that actual revenues are always lower than actual costs as water rates increase. (Cassar-FRC)
W83-01656

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND: SOME NEW INSIGHTS,
Rockefeller Foundation, Jogjakarta (Indonesia).
For primary bibliographic entry see Field 6D.
W83-01730

'SECOND BEST' EFFLUENT FEES IN WATER QUALITY MANAGEMENT: PROBLEMS OF ACHIEVING EFFICIENCY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Revesz, and D. H. Marks.
Water Resources Research, Vol 18, No 4, p 717-720, August, 1982. 17 Ref.

Descriptors: *Water quality managment, *Effluent charges, *Economic efficiency, Water quality control, Administration, Rivers, *Costs, Pollution taxes.

The efficiency characteristics of 'second best' effluent charges are derived by coupling an economic and a physical model. The 'second best' effluent fees which do not consider the physical characteristics of the natural systems do not provide efficient results for water quality managment problems. Fees which include physical characteristics vary with the location of the polluting plant and with the physical parameters (such as temperature and flow rate) of the stream. These conditions require adjustment of fees, posing grave administration burdens. To produce a workable system, polluters in each reach could be grouped and intervals for temperature and flows established. Fees would be varied when physical parameters change from one interval to another. Detailed knowledge of cost functions of the polluters is difficult to assemble; therefore, less than optimum fees may be set and adjusted as experience dictates. Administrative costs for this process are extremely high. (Cassar-FRC)
W83-01744

6D. Water Demand

RESIDENTIAL WATER DEMAND: A POOLED TIME SERIES, CROSS SECTION STUDY OF MALMO, SWEDEN,
Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
S. H. Hanke, and L. de Mare.
Water Resources Bulletin, Vol 18, No 4, p 621-625, August, 1982. 3 Tab, 21 Ref.

Descriptors: *Water demand, *Mathematical equations, *Municipal water, Water supply, Water supply development, *Sweden, Malmo, Water resources development, Sampling, Water sampling.

Shortcomings associated with past water demand studies are evaluated. Attention is focused on water demands for purposes of demand management. Several rules of thumb are presented which are gleaned from this review. First, metered water use data should be collected. Second, data should

be collected that are disaggregated by users within each class. It is suggested that a sample of 20 within each user class should be adequate. Third, data should be collected such as price and water use data over a time series, with 20 time periods and 20 changes in real price being adequate. Fourth, these time series and cross section data should be pooled for purposes of analysis. (Baker-FRC)
W83-01482

GROUND WATER USE IN AN ENERGY DEVELOPMENT AREA: THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,
Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
For primary bibliographic entry see Field 4B.
W83-01508

PREDICTION OF IRRIGATION WATER DEMANDS IN THE SOUTHEASTERN UNITED STATES,
Georgia Univ., Athens. Dept. of Agricultural Engineering.
J. L. Chesness, and D. L. Cochran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150169, Price codes: A03 in paper copy, A01 in microfiche. Georgia Institute of Technology Environmental Resources Center Report ERC 05-82, June 1982, Atlanta. 36 p, 3 Fig, 3 Tab, 14 Ref. OWRT B-146-GA(1).

Descriptors: *Irrigation water, *Water demand, *Prediction, *Mathematical models, *Simulation, *Soil water, *Precipitation, Humid climates, Infiltration, Field capacity, Model studies, Canopy, Moisture tension, Hydrologic budget, Runoff, Evaporation.

Many techniques available for predicting irrigation water demands are applicable only to arid and semiarid climates where the probability of rainfall during the growing season is low. The rapid increase in irrigated acreage in the southeastern region of the U.S. dictates the need to develop methodologies suitable for humid climates. A continuous simulation model was developed for predicting seasonal irrigation water requirements of crops. The model was derived by writing water balance equations for successive soil zones in an irrigated soil profile. The quantity of water infiltrating the uppermost zone was the difference between daily precipitation and runoff. Zonal water volumes exceeding field capacity were passed into the next lower zone. Irrigation was called for whenever calculated soil water removal increased soil water tension to a present level in the profile. Input data to drive the model are: historical or synthetic daily precipitation and pan evaporation values; crop canopy growth factors; soil water tension-content relationships; irrigation water management depth and level (tension); and SCS runoff curve number. Daily measured values of soil water tension and irrigation amounts are obtained for nine crop (corn and soybeans) seasons. Predicted seasonal irrigation water requirements averaged within 11.2% of measured values for eight of the crop seasons. (Moore-SRC)
W83-01608

A CHANCE-CONSTRAINED PROGRAMMING MODEL OF WATER ALLOCATIONS IN UTAH,
Utah Water Research Lab., Logan.
J. E. Keith, G. A. M. Gerstl, R. Narayanan, and D. L. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150227, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-82/06, September 1982. 57 p, 3 Fig, 6 Tab, 57 Ref, 1 Append. OWRT B-182-UTAH(1), 14-34-0001-9141.

Descriptors: *Water allocation, *Water quality, *Resources development, *Energy, *Agriculture, *Computer models, *Utah, *Water supply, Irrigation, Model studies, Water rights, Water storage, Economic aspects.

A chance-constrained separable programming model of water allocations between agriculture and energy production was developed in order to examine the effect of the variability of water supplies in Utah. Using an incomplete gamma function, based on method of moments estimation of parameters, the water flows at 85, 90, and 95% probabilities of occurrence were generated. These flows were then used as constraints in the allocation model. Results indicate that, in general, water quantity is not a significant constraint in regional economic growth in Utah, particularly if water rights are relatively freely transferable. Even under the most severe case examined, only marginally significant changes in irrigated agriculture were evidenced, while major increases in the energy sectors were indicated. Water quality constraints, however, have a significant impact on agriculture, particularly given increasing energy development, since privately financed treatments appear to be economically infeasible for most farmers. The development of storage also appears unwarranted in most cases, because the marginal user of water, agriculture, cannot afford to pay for development. At least in the near term, other impediments to large scale development may be much more important than water availability. (Moore-SRC)
W83-01615

THE FINANCIAL IMPACT OF WATER RATE CHANGES,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 6C.
W83-01656

RURAL WATER SUPPLY AND SANITATION IN SRI LANKA,
Sri Lanka National Water Supply and Drainage Board.
N. D. Peiris.
Aqua, No 4, p 9-12, 1982. 1 Fig, 1 Tab.

Descriptors: *Water supply development, Water resources development, *Sanitation, *Sewage systems, *Developing countries, *Rural areas, *International hydrological decade, Water supply, Water demand, Public health, Potable water, Groundwater potential, Drinking water, *Sri Lanka.

A 1981 census of the Sri Lanka population showed that about 70-75% of the population is rural and lives in estate, wet, or dry zones. The Ministry of Local Government, Housing and Construction must develop water supplies and sewerage for the whole island. Local government agencies facilitate the task of supplying water and sanitation. Some targets to be accomplished during the 1981-1990 Water Decade Plans are to provide 100% of the urban population with safe drinking water, 50% of the rural population with safe drinking water, and 50% of the population with sewage disposal. By the year 2000, full coverage of both water and sanitation is planned. Geology prevents full development of groundwater resources in rural areas. Poor sanitation in rural areas causes about 40% of the cases of water-borne diseases. A number of international agencies are aiding Sri Lanka with water supply development in rural areas. A Model Village Program relocates backward villages to areas with water, sanitation, and better housing. Health education of the public is also planned. Many of the projects are experiencing budgetary problems due to rising inflation. Even with the lack of financial resources, much could be done to follow along the Action Plan prepared under the Decade Program. (Geiger-FRC)
W83-01659

THE IMPACT OF PRICE ON RESIDENTIAL WATER DEMAND: SOME NEW INSIGHTS,
Rockefeller Foundation, Jogjakarta (Indonesia).
C. W. Howe.
Water Resources Research, Vol 18, No 4, p 713-716, August, 1982. 1 Tab, 11 Ref.

Descriptors: *Elasticity of demand, *Water demand, *Water rates, Seasonal variation, Prices, Marginal prices, Domestic water, Economic aspects, *Model studies.

Marginal price elasticites were estimated for the Johns Hopkins Residential Water Use Project data of 1963-65, using newly developed household water demand functions which account for the effects of a rate structure. Winter season elasticity was much lower (-0.06) than the -0.23 calculated in a 1967 study. Summer price elasticities were also lower than previous sstimates, -0.568 versus -0.860 for the easter U.S. and -0.427 versus -0.519 for the western U.S. (Cassar-FRC)
W83-01730

6E. Water Law and Institutions

THE COSTS OF CONFLICTING ENVIRONMENTAL POLICY: A CASE STUDY IN MILWAUKEE,
Wisconsin Univ.-Milwaukee. Dept. of Urban Planning.
G. W. Page, and A. C. Weinstein.
Water Resources Bulletin, Vol 18, No 4, p 671-677, August, 1982. 1 Tab, 23 Ref.

Descriptors: *Financial aspects, *Water pollution control, *Environmental effects, *Milwaukee, Legal aspects, Standards, Combined sewer overflows, Public rights, Clean Water Act, Nonpoint pollution sources, *Wisconsin.

The implications of U.S. water pollution abatement policy for the 13-year history of environmental conflict in Milwaukee are presented. The recent U.S. Supreme Court decision concerning a Milwaukee case is described as a milestone in U.S. water pollution a batement policy which will help preclude the type of environmental policy conflict which has been so costly to Milwaukee. In Milwaukee this conflict was made explicit and costly by a federal court expanding the common law of nuisance to remedy a pollution problem even though existing federal policy clearly addresses the issue. Conflict centered around the uniform national standards specific to the unique characteristics of water bodies; the primacy of the legislature or the judiciary in formulating environmental policy; requirements for secondary versus tertiary sewage treatment; required level of combined sewer overflow protection; percentage of the cost of the pollution abatement project to be paid by local communities; urban vs. suburban conflicts in addressing regional pollution problems; and structural versus alternative and innovative approaches in addressing combined sewer overflow problems.
W83-01502

VERMONT WATER LAW - A SURVEY AND PRIMER,
Vermont Univ., Burlington. School of Natural Resources.
M. B. Lapping.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150326, Price codes: A02 in paper copy, A01 in microfiche. Report, October 18, 1979, 10 p, 250 Ref. OWRT A-035-VT(2).

Descriptors: *Water law, *Riparian rights, *Groundwater, *Vermont, Legal aspects, Water quality, Reasonable use, Water use, Navigable waters.

Vermont is a riparian state, like most jurisdictions east of the Mississippi River. Public and private waters are distinguished by the test of navigability in fact, and the public waters are held in trust by the state. Riparian rights in Vermont are not subject to forfeiture and non-use of the resource does not mean its loss. A riparian right may be granted to a non-riparian through a legal conveyance. The concept of riparianism in Vermont extends to the quality of the resources as well as its quantity. Vermont remains alone among the eastern states in terms of groundwater resources in that absolute ownership exists, unless it can be demonstrated that the underground water lies in a definite underground channel, in which case the reasonable use doctrine applies. Since the 1890's the state and federal governments have gradually extended their authority into the areas of water pollution and the use of surface waters. As this has occurred, the

role of the courts in resolving water resource conflicts has diminished. (Moore-SRC)
W83-01628

A PAPER TIGER: THE SAFE DRINKING WATER ACT,
Greeley and Hansen, Chicago, IL.
A. H. Adams, and T. W. Burke.
Consulting Engineer (St. Joseph), Vol 59, No 3, p 73-76, September, 1982.

Descriptors: *Regulations, *Legal aspects, *Public opinion, *Safe Drinking Water Act, Environmental Pollution Agency, Water pollution control.

On December 16, 1974 the Safe Drinking Water Act was passed, aimed at ensuring that the nation's water supplies would meet minimum national standards and specifying that the Environmental Protection Agency must publish interim primary drinking water regulations within 90 days of passage. Secondary regulations were to be proposed in 270 days. By June of 1982 five amendments to the act had been published. While it is still early to determine the full impact of the regulations, it is certain that they have generated much debate. Provisions that continue to be of great concern include public notification, THM-maximum contaminant level, organic contaminant removal treatment techniques, sampling requirements, effect on small water systems, and administration of the act by those states assuming primacy. (Baker-FRC)
W83-01653

STATE OFFICIALS SOUND OFF ON MOST-PRESSING WATER-QUALITY ISSUES,
G. Dallaire.
Civil Engineering - ASCE, Vol 52, No 9, p 49-52, September, 1982.

Descriptors: *Water quality, *State jurisdiction, Pretreatment of water, Water treatment, Local governments, Organizations, Wastewater facilities, Wastewater treatment, Streams, Construction, Grants, Financial aspects, Texas, Pennsylvania, Ohio, Connecticut, Illinois, Colorado, Clean Water Act, Legal aspects.

Changes which may be suggested by various state water pollution control officials regarding the Clean Water Act of 1977 are considered. Connecticut may seek to push for the states to develop effective pretreatment programs. One of the major reasons for such a push is that Connecticut is one of the states taking a particularly hard stand on this issue, and it is felt this has caused some industry to move from that state to others where less emphasis is placed on this topic. Illinois will probably urge a flexible approach to pretreatment. Colorado will support the idea that wastewater facilities are a local government responsibility. Ohio is suggesting that it is unwise to pursue what appears to officials in that state to be an unreasonable goal-- that of protecting all streams in the state for their highest possible uses at all times. Officials insist there are streams in Ohio on which it would not make sense to spend money to make them fishable or swimmable. Pennsylvania is planning a state-loan program for communities with no hope for getting a federal construction grant. Finally, Pennsylvania is backing innovative treatment systems to stretch dwindling federal grant money. (Baker-FRC)
W83-01654

6F. Nonstructural Alternatives

INSTITUTIONAL ARRANGEMENTS FOR CONTROLLING NONPOINT SOURCE WATER POLLUTION: WISCONSIN'S ROOT RIVER WATERSHED,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
D. S. Sawicki, and L. B. Judd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150342, Price codes: A07 in paper copy, A01 in microfiche. Special Report No 38, March 1982, 135 p, 6 Fig, 16 Tab, 29 Ref. OWRT C-00060-U(No 0484)(1).

Descriptors: *Water pollution control, *Nonpoint pollution sources, *Institutional constraints, *Decentralization, *Social aspects, Wisconsin, Regulations, Land use, Education, Economic aspects, Water quality, Institutions, Incentives, Voluntary actions.

A case study was made of a voluntary, decentralized institutional arrangement for managing nonpoint source water pollution control used in the Root River watershed in southeastern Wisconsin. The watershed was chosen because of its mix of urban, agricultural, and urbanizing land uses. The project objectives were: to monitor and draw conclusions about the effectiveness of a voluntary, decentralized institutional system; to specify deficiences of the approach and suggest means to correct them; and to use the conclusions to speculate about the need for regulations regarding nonpoint source pollution control or the appropriateness of financial incentives for nonpoint source control. Institutional factors considered include: diversity of land uses in the watershed, educational needs, economic conditions, personality, water quality considerations, number of agencies involved, definition of authority, and bureaucratic requirements. It was concluded that decentralization is desirable only when it serves a very clear, very important purpose. It is clearly inefficient and the problems related to it multiply rapidly as additional organizations and agencies are added. Use of a voluntary approach is largely a philosophical choice, and while it works for some practices, it is also inefficient. (Moore-SRC)
W83-01630

6G. Ecologic Impact Of Water Development

WATERSHEDS IN MUSKEG TERRAIN. 2. EVALUATIONS BASED ON WATER CHEMISTRY,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W83-01497

THE ECOLOGICAL EFFECTS OF LOG SALVAGING FROM RESERVOIRS,
Maine Univ. at Orono. Land and Water Resources Center.
J. R. Moring, K. E. Gibbs, M. T. Negus, and P. D. Eiler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150060, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, November 1982. 44 p, 5 Fig, 5 Tab, 41 Ref, 8 Append. OWRT B-020-ME(1).

Descriptors: *Ecological effects, Fish, Fisheries, *Logging, Reservoirs, Water quality, *Log salvaging, *Maine, *Perch, Water pollution effects, *Submerged logs, Invertebrates, Water pollution sources, Wyman Lake, Indian Pond.

Pulpwood log drives in Maine, from the 1830s to 1976, left an estimated 1-2 million cords of logs submerged in the Kennebec River system, principally in two reservoirs: Wyman Lake and Indian Pond. Favorable economics have led to commercial log salvaging in these two reservoirs and elsewhere. Because of the large quantities of submerged logs in the northeastern United States and eastern Canada, interest is high concerning the ecological impact of such salvaging. Yellow perch did not show a strong attraction for submerged pulpwood logs, though other species did, indicating that removal could have some impact on available cover for fishes. The proportion of bark in the sediment was considerably higher in unsalvaged sites, and density of macro-invertebrates on logs in unsalvaged sites was twice that of logs remaining in salvaged sites. The colonization potential of newly submerged logs is apparently not impaired by log salvaging, but salvaging can have short-term effects on water quality and certain direct and indirect effects on fishes and invertebrates. Log salvaging will have greater ecological impacts on areas where logs are not situated flat on the bottom, but stacked, where the diversity of cover sites for fishes and substrate for invertebrates is higher.
W83-01575

DOWNSTREAM EFFECTS OF THE GORDON RIVER POWER DEVELOPMENT, SOUTH-WEST TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
R. D. King, and P. A. Tyler.
Australian Journal of Marine and Freshwater Research, Vol 33, No 3, p 431-442, 1982, 13 Fig, 13 Ref.

Descriptors: *Dam effects, Estuaries, *Meromictic lakes, Water resources development, *Hydroelectric plants, Environmental effects, Ecological effects, Reservoirs, Holomictic lakes, Lakes, Meromixis, Water circulation, Stratification, *Australia, Tasmania, Gordon River.

A survey of the physicochemical limnology of the Gordon River designed to give background data for stage 2 of the Gordon River Power Development has shown the effects of the dams of stage 1. A damping of seasonal flow variations was observed, so that the regulated river experiences higher summer flows and lower winter flows. Summer growth of photosynthetic algae in shallows and riffle zones no longer occurs, while other biological ramifications have yet to be investigated. River headwaters now form the hypolimnetic strata of the reservoir, Lake Gordon. The river is now fed with a discharge of nearly uniform chemical composition and temperature. An estuarine underflow of salt water on which the meromixis of three lakes depends has been eliminated by the stage 1 dams. One of these lakes has become holomictic since the discharge from the dam began. During a brief shutdown of the power station, a temporary return to meromixis was observed, showing that the lake could retain its meromictic conditions if a proper operating regime was maintained. (Geiger-FRC)
W83-01588

ALTERED HYDROLOGY OF THE MISSOURI RIVER AND ITS EFFECTS ON FLOODPLAIN FOREST ECOSYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
W. C. Johnson, P. W. Reily, L. S. Andrews, J. F. McLellan, and J. A. Brophy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150110, Price codes: A05 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin 139, November 1982. 83 p, 13 Fig, 9 Tab, 2 Microfiche, 59 Ref. OWRT B-108-VA(1).

Descriptors: *Floodplains, *Floodplain protection, Floods, *Forests, Dams, Riparian, Vegetation, Rivers, River meandering, Growth, Survivorship, Land use, *North Dakota, *Missouri River, *Riparian ecosystems.

A river system's hydrologic regimen, having been altered by the construction and operation of a floodplain protection project, has long been suspected of having major, long-term effects on the natural dynamics of riparian ecosystems that remain in gaps between large reservoirs. This study confirms that hypothesis by documenting some of those impacts in an area between Garrison Dam and Oahe Reservoir on the Missouri River in south-central North Dakota. Specifically, it examines post-dam changes in river meandering rate, floodplain forest composition, tree population structure, and tree growth rate. Post-dam hydrologic regimen differs markedly from pre-dam regimen. Evaluation of data collected revealed that Garrison Dam and Oahe Reservoir have had significant impact on the area's riparian ecosystem, including altering streamflow patterns; eliminating much of the flooding and silt deposition that had occurred along the pre-dam river; decreasing river meandering rates but widening the river channel; causing a decline in radial tree growth in species whose natural sources of moisture have been altered by the dam; changing the composition of

floodplain forests by preventing regeneration of some species and lowering seedling survivorship of others; and encouraging the clearing of floodplain forests for agriculture with improved irrigation opportunities. Results of this study should have application to forests on other floodplains where the natural hydrologic regimen has been altered by man. This research should stimulate further study of riparian ecosystems so that a more general assessment can be made of the ecological effects of floodplain protection.
W83-01603

ENVIRONMENTAL ISSUES OF LIQUID TRANSPORTATION FUELS FROM COAL,
Oklahoma Univ., Norman.
For primary bibliographic entry see Field 5B.
W83-01743

7. RESOURCES DATA

7A. Network Design

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTHWEST LAND MANAGEMENT AND CONSERVATION RESEARCH CENTER,
Agricultural Research Service, Pullman, WA. Land Management and Water Conservation Research Unit.
K. E. Saxton, and D. K. McCool.
In: The Quality of Agricultural Research Service Watershed and Plot Data; Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., Blaisdell, F. W., eds. p 160-165, 2 Tab, 4 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Agricultural runoff, Soil erosion, Tillage, Crop production, Dry farming, Freezing, Snow, Sampling, *Washington, Palouse.

Research at the Center is to determine effective tillage and cropping systems for the Pacific Northwest Region, with particular interest to the dryland farming area of Washington, Oregon, and Idaho. The Palouse area of eastern Washington and northern Idaho is an area of specific interest because of its high productivity, severe erosion, and water quality problems. The acquisiton of data in this region requires maintaining excellent measurement calibration and reliability during the winter months, because that is when essentially all hydrologic activity occurs. Cold weather, snow, ice, and muddy and frozen soil must be dealt with. Temperatures frequently hover near the freezing point, causing precipitation to vary from rain to snow, often within the same event period. Precipitation and runoff rates are normally very low intensity, but significant erosion and chemical movement occur during these cold conditions. for precipitation, measuring snow and maintaining clocks in cold weather are the two most difficult problems. Streamflow measurement and sampling can be adequately accomplished using enclosed shelters, but this is difficult and expensive. The quality of precipitation and streamflow data is largely related to instrument design and reliability, whereas sediment and chemical data are more determined by sampling frequency and representativeness. (Moore-SRC)
W83-01449

SLEEPERS RIVER RESEARCH WATERSHED, DANVILLE, VERMONT,
H. B. Pionke, R. L. Hendrick, and B. J. Chamberlin.
In: The Quality of Agricultural Research Watershed and Plot Data; Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C.W.; Farrell, D. A.; and Blaisdell, F. W., eds. p 146-153, 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, Raingages, Snow, Freezing, Storm seepage, Return flow, *Vermont, Sleepers River Research Watershed.

The Sleepers River Research Watershed was created to provide additional knowledge on the physical behavior of natural watersheds, and to solve specific hydrologic problems of the New England area. Dispite a shift in emhasis to analysis and interpretation of data, considerable resources were still directed toward data collection until the closing of the Research Watershed in 1979. The precipitation measurement network included 35 sites that contained weighing, recording raingages; 20 of these sites had snow courses. Severe winter climate conditions caused some missing or poor quality data. Runoff was measured for the 16 subwatersheds from a combination of known stage and control-point geometry. The control points were either flumes or weirs. Flow measurements during winter and early spring were usually accurate or correctable under stable flow conditions because of daily ice removal procedures. Where flow peaks or unstable flow rates were associated with excessive ice buildup or ice jams, the record is much less accurate. One problem was to measure quick (interflow) and total subsurface return flow in a system where classic hydrograph separation techniques may provide the least accurate estimates of surface and subsurface return flows of any place in the U.S. (Moore-SRC)
W83-01450

REPORT ON QUALITY OF PRECIPITATION, RUNOFF AND EROSION PLOT DATA FROM THE COLUMBIA PLATEAU CONSERVATION RESEARCH CENTER,
J. F. Zuzel, R. R. Allmaras, and R. N. Greenwalt.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 124-129, 2 Tab, 7 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Soil erosion, Agricultural runoff, Sampling, Fertilizers, Rain gages, Snow, Columbia River Plateau.

The mission of the Center is to carry out research for developing better practices, techniques, and equipment for crop protection, and soil and water conservation in the Columbia River Plateau and related land resource areas. Each fall, fully instrumented sites are installed to gather data. The sites are located over a wide geographical area in northeastern Oregon. Each plot is designed to collect into holding tanks all of the runoff and erosional materials produced. Each site is also equipped to continuously record soil temperature, air temperature, relative humidity, and precipitation. When a runoff event occurs, water and sediment samples are collected from the holding tanks. Catch deficiencies were associated with propane heated, tipping bucket rain-gages. Weighing type recording raingages provide good data quality despite occasional recorder malfunctions. Sampling of snow water equivalent in areas of transient and discontinuous snow pack presents additional problems. Estimates of total runoff are excellent, as are estimates of hourly runoff. Determinations of total sediment obtained from sampling the holding tanks are considered very good. Samples obtained from the holding tanks provide good estimates of fertilizer-type chemical concentrations. (Moore-SRC)
W83-01453

REPORT ON QUALITY OF WATERSHED DATA FROM THE WATER CONSERVATION STRUCTURES LABORATORY, STILLWATER, OKLAHOMA,
W. R. Gwinn.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 111-113, 7 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, Wind, Snow, Weirs, Culverts, Silt, Pumps.

Precipitation and runoff data were needed for the design of soil and water conservation works in grassland areas of the Reddish Prairies of Oklahoma, Texas, and Kansas. This also provided an opportunity for research on the development of an inexpensive runoff measuring device that utilized existing highway culverts. Three watersheds, adjacent to and draining toward a highway were selected. Water level and precipitation recorders were installed in June 1951 and operated continuously until 1973. Good quality precipitation data depends on the alertness, care and training of the observer, as well as on the device or instrument being used. Precipitation records are also subject to errors due to wind, snow and convective thunderstorms. Highway culverts equipped with Villemonte weir sills were evaluated as flow measuring devices. Some difficulty was experienced with a twin culvert because the water does not always divide evenly between the two barrels. Silt deposition and low flow caused difficulties in obtaining accurate measurements of runoff pump malfunction was the major source of operational error in sediment concentration measurement. (Moore-SRC)
W83-01455

ACQUISITION AND QUALITY OF WATERSHED DATA FROM THE SOUTHERN PLAINS WATERSHED AND WATER QUALITY LABORATORY,
Agricultural Research Service, Durant, OK. Watershed and Water Quality Lab.
S. J. Smith, P. B. Allen, and F. R. Schiebe.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 104-110, 18 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Agricultural runoff, Storm runoff, Detritus, Sand, Silt, Sampling.

The mission of the Southern Plains Watershed and Water Quality Laboratory, headquartered at Durant, Oklahoma, is to develop information needed to protect and manage the quality of the nation's water resources arising from agricultural and non-urban lands. Watersheds at Chickasha, Oklahoma, and cooperating locations at El Reno and Woodward, Oklahoma, and Bushland and Temple-Riesel, Texas, generate basic data and information for analysis at the laboratory at Durant. No particular problems have been reported with the raingage network installed in the Washita River Basin. Runoff data has been collected for 80 watersheds. Measurement problems associated with freezing are rare, but problems associated with high sediment loads do exist. High concentrations of fine sand, very fine sand, and coarse silt create problems for precalibrated weirs. Trashy stormflow hampers making accurate discharge measurements. Virtually all suspended sediment problems result because the concentration of sand and coarse silt is poorly distributed in the flow cross-section, especially with depth. A particular problem has been obtaining a representative total sample (water plus sediment) for chemical analysis in runoff containing course sediment particles. (Moore-SRC)
W83-01456

QUALITY OF WATERSHED DATA AT THE NORTH APPALACHIAN EXPERIMENTAL WATERSHED, CONSHOCTON, OHIO,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
T. J. Harlukowicz, J. V. Bonta, W. M. Edwards, and C. R. Amerman.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 91-103, 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Rain gages, Snow, Weirs, Flumes.

Group 7A—Network Design

The present mission of the North Appalachian Experimental Watershed is to develop procedures for predicting the movement of water, sediment, and chemical constituents in the landscape and to develop and evaluate management systems as to their effects upon such movement. The diversity of the research program at Coshocton and the environmental situations which must be accommodated in accomplishing the research objectives requires the maintenance of an extensive data acquisition system consisting of numerous components. Precipitation data are derived from twelve weighting, unshielded, recording raingages, one weighing, dual recording gage and one pit gage. The quality of the precipitation data is affected by three factors: the inherent tendency of standard recording rain gages to undercatch precipitation; the mechanical performance of a raingage; and human error during servicing. Broad crested V-notch weirs, H-flumes, a Columbus deep notch weir, and drop-box weirs are the principal flow measuring devices used to gage stream flow. Mechanical problems and human errors also affect the accuracy of runoff data. Sediment concentrations in runoff are measured by the Conshocton wheel on small watersheds and the rotating vane sampler on larger watersheds. Sediment transport values accurately define transport through the weir, but do not account for coarse material deposited in the pool above the weir. The accuracy of chemical transport data is dependent primarily upon the accuracy of the runoff data. (Moore-SRC)
W83-01457

REPORT ON QUALITY OF WATERSHED DATA, USDA SEDIMENTATION LABORATORY,
N. L. Coleman.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 80-86, 2 Fig, 4 Ref.

Descriptors: *Data acquisition, *Automation, *Precipitation, *Runoff, *Sediments, *Water quality, Soil erosion, Storm runoff, Manpower, Costs, Sampling.

The USDA Sedimentation Laboratory carries out an extremely diverse program of fundamental research into all aspects of soil erosion and sediment production the transport of sediment by streams, and the deposition of sediment in stream channels, flood plains and reservoirs. The laboratory maintains four instrumented watersheds: Pigeon Roost Research Watershed; the Goodwin Creek Research Watershed; the Unit Source Watershed Complex; and the Flatland Watershed Complex. In choosing components for a watershed data acquisition system, emphasis can be placed on the use of manpower for making measurements, which requires that a reasonable number of personnel be distributed over the watershed during storms, or upon the use of automated equipment. The successful operation of automated equipment requires the constant activity of a large team of maintenance personnel, so that there is little difference in actual manpower requirements between manned and automated systems, and little economic difference. The quality of different kinds of watershed data can be widely different. Precipitation data is generally good, although special problems may arise when rain gages are affected by wind and other problems. Runoff data may be adversely affected by sediment deposits. The quality of sediment data is good for fine material, but poor for coarser material. Water quality data may be affected by sample contamination. Radio telemetry systems require constant maintenance or redundancy to provide good data quality. (Moore-SRC)
W83-01459

QUALITY OF WATERSHED RELATED DATA COLLECTED AT THE SNAKE RIVER CONSERVATION RESEARCH CENTER,
D. L. Carter.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Johnson, C. W.; Farrell, D. A.; and Blaisdell, F. W., eds. Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. p 60-61, 11 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, *Agricultural runoff, Conservation, Irrigation, Rain gages, Chemical analysis, Idaho, Snake River Conservation Research Center.

The mission of the center is broad and encompasses research on a wide variety of soil, water and energy problems prevalent on irrigated and dryland farms. Research objectives are directed toward regional problems. Much of the research is directed toward developing practices to improve production efficiency on farms by conserving energy, soil, water and plant nutrients. The center is located in an area with about 8.5 inches of precipitation per year and precipitation data are obtained from recording lysimeters and nonrecording rain gages. Runoff is measured by precalibrated flumes, weirs and on occasion by current metering. Runoff measurements are generally replicated several times to obtain mean values for irrigation furrows. Occasionally, plugged inlets or equipment failure is encountered at recording stations. Sediment concentrations are measured by filtering known volume samples, drying the filters, and weighing the sediment. Generally the entire furrow stream is collected for a short period as a sample. Chemical concentration measurements are labor intensive so that a major portion of technician time is used in this effort. Samples are refrigerated until analyses are made to minimize changes induced by elevated temperatures. (Moore-SRC)
W83-01463

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTHWEST WATERSHED RESEARCH CENTER, BOISE, IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. W. Johnson, C. L. Hanson, G. R. Stephenson, and K. R. Cooley.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 50-59, 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Data acquisition, *Precipitation, *Snow, *Runoff, *Rangelands, Snowmelt, Rain gages, Streamflow, Sediments, Water quality, Bacterial analysis, *Idaho, Reynolds Creek watershed.

The mission of the Northwest Watershed Research Center is to: determine precipitation amounts and distributions, including snow accumulation and melt; study runoff and streamflow; formulate and test models of rangelands. The 90 sq mi Reynolds Creek Watershed was selected to represent extensive sagebrush rangelands of the interior Northwest. Since a significant portion of annual precipitation on the experimental watershed is snow, major emphasis has been placed on the development of techniques and instruments for measuring winter precipitation, snow accumulation, snowmelt, runoff, and sediment transport. The major problems with measuring rain and snowfall are the amount of time and the personnel required to obtain accurate data. Original streamflow gaging stations with natural controls were unacceptable on Reynolds Creek because of extreme changes in channel cross-sections during flood events. Therefore, precalibrated weirs or flumes, were installed at all stations. Ice buildup and sediment deposition have caused problems at times. Automatic pumping samplers at remote sites with difficult access during storms and floods present numerous problems in obtaining representative sediment concentration data. Because of low background concentrations of most chemical constituents and the absence of applied herbicides, pesticides, and fertilizers at these sites, effort has been concentrated on bacterial indicators to denote changes in management practices, irrigation return flows, and streamflow variations. (Moore-SRC)
W83-01464

REPORT ON QUALITY OF WATERSHED DATA FROM THE HAWAII SMALL WATERSHED PROJECT,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W. eds. p 43-49, 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Data acquisition, *Precipitation, *Sediments, *Runoff, *Soil loss, Pineapple, Rain gages, Sugarcane, Agricultural runoff, Sampling, Roads, *Hawaii, Oahu.

Between 1971 and 1979, soil loss studies were conducted on six, small, cropped watersheds on representative residual and volcanic ash soils in Hawaii. Two of these watersheds, planted to sugarcane, are on the island of Hawaii. The other four are on the island of Oahu; one in sugarcane, two in pineapple, and one in both crops. Critical depth flumes with waterstage recorders were used to provide a continuous record of the runoff from the watersheds. Precipitation was measured with recording raingages located on or adjacent to each watershed. A proportionate sample of the runoff water was collected for sediment analysis with specially designed and calibrated sediment samplers at the outlet of each flume. Problems were encountered with the recording raingages, which caused a loss of some data with sugarcane and pineapple crops, bare or limited cover conditions exist for only a small portion of the cropping cycle. Most of the runoff data is obtained under low sediment conditions and is of excellent quality. The runoff was influenced by the percentage of area occupied by roads. The biggest problem associated with runoff measurement was caused by the sediment carried by large or high intensity storms, particularly when the fields were bare. The main sampling problems were encountered during very low flows and very high flows. (Moore-SRC)
W83-01465

REPORT ON QUALITY OF PLOT AND SMALL WATERSHED HYDROLOGIC DATA FROM THE SOUTHERN PIEDMONT CONSERVATION RESEARCH CENTER,
A. W. Thomas, and G. W. Langdale.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., Blaisdell, F. W., eds. p 35-42, 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Data acquisition, *Small watersheds, *Sediments, *Runoff, *Precipitation, *Water pollution, Thunderstorms, Water quality, Sampling, Water pollution sources, Agricultural chemicals, Sediment transport, *Georgia, Watkinsville.

The mission of the Research Center is to develop wise, efficient, economical, and effective agricultural uses of the natural resources of the Southern Piedmont area. Four watersheds ranging in size from 3 to 7 acres are used for studies on runoff, sediments and chemical transport. Due to the necessity of accurate rainfall data on the small watersheds, maintenance of gages is performed thrice weekly and other times when rain is expected. Problems exist in adequate representation of rainfall for localized thunderstorms. Runoff measurement devices are placed at natural drainage points or drainageways on the small watersheds. The major difficulty with the runoff data is clock differences in rainfall and weir flow. The sediment concentration varies tremendously due to the condition of the watersheds and the nature of the storms. Continuous runoff sampling is achieved with a motorized sampling slot traversing through the flume discharge. The transport of dissolved and absorbed agricultural chemicals from the four small watersheds has been studied in association with the study of sediment transport. (Moore-SRC)
W83-01466

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE SOUTHEAST WATERSHED RESEARCH LABORATORY.
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Laboratory.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 20-34, 2 Tab, 18 Ref.

Descriptors: *Data acquisition, *Precipitation, *Sediments, *Water quality, *Flow, Water analysis, Watersheds, Hydrologic data, Streamflow, Sampling, *Georgia, Little River watershed.

The mission of the Southeast Watershed Research Laboratory (SEWRL) is to develop concepts of watershed stream performance based on an understanding of hydrologic, sediment, and chemical transport processes, and to develop methodologies for predicting and evaluating the impact of agricultural management practices on the environment and natural resources. Streamflow measurement and water quality sampling are difficult in Coastal Plains and Coastal Flatwood areas because of: low stream gradients; woody vegetation in the riparian zone, which causes low velocities and large volumes of backwater; and high infiltration rates. Fifty-six digital raingages that record cumulative rainfall at 5-minute intervals have been installed at the Little River Watershed (LRW). Precipitation data quality problems are largely related to recording accuracy, time interval of sampling, and estimation of data when gages malfunction. Flow measurement devices used on the LRW have generally functioned as designed. Structural problems are minimal; controls are relatively self-cleaning, and the low sediment presence does not lead to significant buildup. Problems associated with sediment concentration determinations are those of inadequate representation in time and location of sample collection. Laboratory analysis of samples is also a problem since sediment concentrations are generally low. The quality of most of the determinations of water quality parameters are considered to be good to excellent. (Moore-SRC)
W83-01467

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE AGRICULTURAL/SURFACE-MINED HYDROLOGY RESEARCH GROUP, FORT COLLINS, COLORADO,
D. G. Decoursey.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manual ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 13-19, 2 Tab.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Chemical analysis, Watershed management, Strip mines, Environmental effects, Water pollution, Snow accumulation, Spatial distribution, *Colorado, Routt County.

The mission of the research group is to measure and understand basic hydrologic processes and plant-soil-water relations so that better watershed management practices can be developed for agricultural and surface-mined areas, and the environmental effects of such practices can be predicted. Major emphasis is being placed on estimating the effects of various management practices on the movement of water, sediment and chemicals from surface mined lands, and in the development of mathematical models of hydrologic systems. All precipitation, runoff/streamflow, sediment concentration and chemical concentration data are collected from plots and watersheds located in Routt County. Accessibility is the single most significant problem associated with data collection: deep snow in the winter and muddy conditions during the spring measurement of precipitation is the lack of representative measures of spatial variability in both snow accumulation and rainfall. Runoff records from both the plots and small watersheds are probably the most accurate of all records. Problems of accuracy in sediment concentration estimates come primarily from representativeness of point samples as compared to cross section average. The most significant problems of chemical concentration are these associated with errors in the sediment concentration. (Moore-SRC)
W83-01468

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER,
Agricultural Research Service, Tucson, AZ. Southwest Rangeland Watershed Research Center.
K. G. Renard.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 1-10, 3 Fig, 15 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Water quality, *Rangeland, *Sampling, Watersheds, Sediment load, Hydrology, Rain gages, Ephemeral streams, Arizona, New Mexico.

The mission of the Southwest Rangeland Watershed Research Center (SWRWRC) is to study the hydrology of rangeland watersheds and the effects of changing land uses and practices on the hydrologic cycle. Data from experimental areas in Arizona and New Mexico are used in the study of the quality and quantity of water from southwestern rangelands. Precipitation studies in the southwestern U.S. require a dense network of recording raingages. Problems include the demands for servicing the mechanical recorders, digitizing the records, and maintaining the mechanical components. Runoff in ephemeral streams creates some extraordinary problems of measurement. The combination of high velocities, rapidly changing flow depths, and high sediment loads preclude field measurements with conventional technology. Supercritical measuring devices have been developed for these flow conditions. One of the more serious problems in watershed research is sediment concentration measurement. Pump samplers and moveable slot samplers are used by SWRWRC. One major data quality problem with the precipitation studies is that each sampling point uses an independent time reference (clock). There are problems with runoff recordings because of difficulties with station maintenance. Many of the problems with sediment concentration are associated with selection of an appropriate sampling point. The methods for determining both the concentration and the particle-size distributions also cause problems. Research on chemical concentrations associated with runoff requires accurate runoff data, sediment concentration data, and laboratory equipment for measurement. (Moore-SRC)
W83-01470

7B. Data Acquisition

GRASSLAND, SOIL AND WATER RESEARCH LABORATORY, TEMPLE, TEXAS,
Agricultural Research Service, Temple, TX.
C. W. Richardson.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 139-145, 2 Tab, 4 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Rain gages, Weirs, Flumes, Automation, Sampling.

The primary mission of the research at the Grassland, Soil and Water Research Laboratory is to determine the hydrologic effects of conservation practices, management, and watershed characteristics. In recent years, emphasis has been placed on developing quantitative descriptions of the physical processes of evapotranspiration, infiltration, surface runoff, and sediment and chemical movement. A raingage network of various densities has been maintained since 1936 on a 9 sq mi area. A weighing-recording raingage and a standard non-recording raingage are located at each site. The total amount of rainfall recorded by the recording gage is often significantly different from the amount caught by the non-recording gage. The quality of the precipitation data is good considering the normal limitations of precipitation measurement. The runoff measuring devices that have been used include H-flumes, broad-crested v-notch weirs, Parshall flumes, and field-calibrated artificial controls. The data obtained are of good to excellent quality. The V-notch weirs provide data of questionable quality because of sediment deposition upstream during runoff events. Automatic pumping samplers provide an excellent technique for sampling the fine materials transported in runoff at this location. Water quality data are, in general, of good quality. However, some data quality problems may be caused by exposure of samples to high temperatures in the field and by extended storage before analysis. (Moore-SRC)
W83-01451

QUALITY OF WATERSHED DATA FROM THE NORTHEAST WATERSHED RESEARCH CENTER,
W. J. Gburek, and R. N. Weaver.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 130-138, 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Groundwater, *Automation, Streamflow, Sediments, Freezing, Weirs, *Pennsylvania, East Mahantango Creek watershed.

The Northeast Watershed Research Center is chartered to conduct research on the hydrology and associated chemical and sediment transport resulting from land use and management inherent to the northeastern United States. The majority of field research is conducted within the East Mahantango Creek Watershed, a 162-sq-mi area tributary to the Susquehanna River in Pennsylvania. For recording routine precipitation, streamflow, and groundwater levels, an automated data collection system is used. The gages record data in modified binary digital formation on paper tape. There are no major problems with the precipitation data collected on the watershed. Timing within and between routine precipitation records is excellent, since the electronic timers are extremely accurate over long periods of time. Streamflow data on the watershed is considered good. Sediment in weir ponds is removed yearly to maintain proper approach. Some limitations exist for winter data due to ice on the weir notch or covering the stream. The quality of groundwater level data is excellent. Wells were installed so as to minimize leakage from the land surface to the bore hole. (Moore-SRC)
W83-01452

DISCHARGE RATINGS OF A SANTA RITA FLUME, WATER CONSERVATION STRUCTURES LABORATORY, STILLWATER, OKLAHOMA,
W. R. Gwinn.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 114-123, 8 Fig, 3 Ref.

Descriptors: *Flumes, *Runoff, *Sediments, *Flow rates, Soil erosion, Roads, Flow discharge, Watersheds, Oklahoma, Little Washita watershed.

A Santa Rita type flume is being used to measure runoff and sediment from roadside erosion in the Little Washita watershed near Chickasha, Oklahoma. Tests were run to determine the discharge characteristics of the flume, and discharge ratings were computed. The computed rating can be used for heads greater than 0.4 ft with expected errors of approximately 5% depending on the coefficients chosen. For heads less than 0.4 ft, the flume should be field-rated for sites where large size sediment is expected. The computed rating should not be used for H less than 0.1 ft. Three events from the

roadside watershed (area 7.83 acres) with accumulated runoffs of 0.852, 0.241, and 0.0452 inches were recmputed using correction factors estimated for unrestricted flat approach. The corrected values were 0.786, 0.230, and 0.0312 inches, respectively. The mathematical computed rating over predicted by 7.7, 4.6, and 31%, respectively. The measurement of small events involves large errors as might be expected. A maximum discharge of 33.4 cu ft/s for H = 1.5 ft was listed in the rating table. However, the flume overtopped at the entrance for a head of approximately 1 ft with a maximum discharge of 10 cu ft/s. For flows above 1 ft, the indicated head would give discharge values too low due to overtopping. Sampling of sediment from the flume is a problem that needs further study. (Moore-SRC)
W83-01454

REPORT ON QUALITY OF DATA FROM THE DEE CREEK WATERSHED, LINCOLN, NEBRASKA,
J. S. Schepers, and G. E. Schuman.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 87-90, 2 Tab, 1 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Conservation, Agricultural runoff, Weirs, Dissolved oxygen, Bacterial analysis, Water pollution sources, Sampling, *Nebraska, Dee Creek watershed.

The mission of the Soil and Water Conservation Research Unit is to study and develop improved methods of soil, water, and crop management that will maintain or improve productivity and also conserve soil, water and energy resources. The Dee Creek study was initiated in 1974 to compare the characteristics of runoff from a relatively large agricultural watershed (2200 ha) to those of smaller projects and also to statewide water quality evaluations. The precipitation recording network was primarily established to measure spatial variability of rainfall during the period when the soil was not frozen. The major problem encountered was with the spring-wound clocks. Reliable operation was achieved by annual maintenance. Few problems were encountered with the operation of the runoff gaging equipment and weir except during a 3-4 day period in the spring when snow melted and ice collected in front of the weir. During the first year of the study a continuous monitoring dissolved oxygen probe was used: however, its unsatisfactory operation was overcome by performing these analyses on baseflow samples collected weekly. Bacteriological sampling was discontinued after 1976 because it was determined that the wide variations in coliform counts were due to natural conditions rather than feedlot runoff or sewage systems in the watershed. (Moore-SRC)
W83-01458

NORTH CENTRAL WATERSHED RESEARCH UNIT, COLUMBIA, MISSOURI,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
A. T. Hjelmfelt, Jr.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds., p 74-79, 2 Tab, 10 Ref.

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Agricultural runoff, Conservation, Rain gages, Sampling, Automation.

The role of the Watershed Research Unit is to conduct research on soil and water conservation practices on agricultural watersheds in the cornbelt states. The particular subjects studied are watershed hydrology, erosion and sedimentation processes, and water quality. Research sites are located in the deep loess region of southwestern Iowa and the claypan region of north central Missouri. Weighing recording rain gages are used at all locations. The major problem with precipitation measurements results from separate timing for each rainfall and runoff recorder. Small time differences may be significant in analysis of rapidly responding sites. Runoff measurements are based primarily on precalibrated structures such as weirs and flumes. High sediment concentrations and flood plain inundation cause difficulties in measuring runoff. Automatic samplers used to monitor sediment concentrations have failed due to electrical and mechanical problems, plugging with sediment, and inadequate flushing. Electronically programmed samplers have been susceptible to reprogramming by lightning. Chemical concentrations are sampled with the same apparatus used for sediment concentration and so have the same problems. The greatest sources of error are probably chemical transformations which may occur prior to analysis and the lack of representativeness in the samples collected. (Moore-SRC)
W83-01460

REPORT ON QUALITY OF WATERSHED AND PLOT DATA FROM THE NORTH CENTRAL SOIL CONSERVATION RESEARCH LABORATORY,
C. A. Onstad.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 71-73

Descriptors: *Data acquisition, *Precipitation, *Runoff, *Sediments, *Water quality, Snow, Freezing, Wind, Drifting snow, Erosion, Particle size, Water quality, Sampling.

The laboratory mission is to conduct research on soil and water conservation problems in the northern Corn Belt to insure maximum productivity with minimum detrimental effects on the environment. The major problem with precipitation measurements is that of measuring snowfall and mixtures of rain and snow. During high wind conditions, snow catch measurements in raingages are relatively unreliable. Equally difficult to measure are the amounts of snow on the ground due to drifting conditions. The biggest problem associated with measuring runoff from natural plots and small watersheds is intermittent freeze-thaw cycles that occur nearly every day for 2-3 weeks during early spring. Floats freeze in stilling wells, intakes freeze, and sometimes an ice crust forms in the approach. The selection of an appropriate sampling point is an important consideration for collecting sediment concentration data. Also important for studying erosion dynamics are the particle-size distributions of sediments. Accurate determinations of aggregate size distribution are difficult. For chemical determinations, sample handling methods after collection are very important. (Moore-SRC)
W83-01461

LABORATORY TESTS OF WATER LEVEL RECORDERS AND BROAD-CRESTED V-NOTCH WEIRS FROM THE ST. ANTHONY FALLS HYDRAULIC LABORATORY, MINNEAPOLIS, MINNESOTA,
F. W. Blaisdell.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Johnson, C. W.; Farrell, D. A.; and Blaisdell, F. W., eds. Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. p 64-70, 16 Ref.

Descriptors: *Data acquisition, *Flow measurement, *Water level recorders, *Sediments, Flumes, Weirs, Precision, Accuracy, Sediment load.

The mission of the Hydraulics of Structures Research Unit at the St. Anthony Falls Hydraulic Laboratory is to develop new and improved structures for the control, use management, and measurement of water. Tests on 38 water level recorders of 11 different types were made by mounting each recorder over a water tank and comparing the chart record with the level determined with a point gage. There are 9 sources of error in the stage recording mechanism of float type water level recorders: friction; line shift; counterpoise and line submergence; surface tension, momentum; backlash; instrument errors; line length changes; and chart expansion. Both the accuracy and precision of flow measurements may be affected by sediments in the flow. The broad-crested V-notch weir has low and undeterminable accuracy if heavy sediment loads deposit in the approach channel. If a high velocity Walnut Gulch or Santa Rita measuring flume is used so sediment is transported through the flume, the flume rating may produce less precise data, but the lack of sediment deposition will improve the measurement accuracy. (Moore-SRC)
W83-01462

REPORT ON QUALITY OF PESTICIDE RUNOFF DATA FROM THE SOIL AND WATER MANAGEMENT RESEARCH UNIT, RIVERSIDE, CA,
W. F. Spencer.
In: The Quality of Agricultural Research Service Watershed and Plot Data, Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-31, Oakland, Calif., August 1982. Johnson, C. W., Farrell, D. A., and Blaisdell, F. W., eds. p 11-12, 1 Ref.

Descriptors: *Data acquisition, *Pesticides, *Irrigation water, *Surface runoff, *Tile drainage, *Water pollution sources, Irrigation practices, Return flow, Pesticide residues, Agricultural runoff, Organophosphorus pesticides, Sample preservation, *California, Imperial Valley.

The research program of the Soil and Water Management Research Unit includes field and laboratory experiments to determine the amounts of pesticides in surface runoff and ground water as affected by pesticide application and irrigation management practices. For this purpose, amounts of pesticides are being measured in irrigation return flows from surface irrigation runoff water and tile drainage water from large fields under various irrigation practices used by farmers in the Imperial Valley of Southern California. The fields are instrumented with propellor water meters for measuring incoming irrigation water, Parshall flumes for measuring outgoing runoff water, and slotted tubes on tilelines for measuring tile drainage water. Since most of the pesticides in irrigation return flows are found in the surface-runoff water, the measurement of runoff volume is of major concern in calculating total pesticide runoff. Based on the relationship between pesticide concentration and the runoff hydrograph, runoff water is sampled most frequently during the first irrigation after a pesticide application. Sample integrity, with regard to stability of pesticides, is maintained by transporting the samples under ice and storing at 4C. Problems encountered in maintaining instrumentation performance and site conditions include; occasional malfunction of chart recorders; and submerged or overflow conditions where drop inlets into the main drain ditch are not large enough. Some organophosphate insecticides were unstable during storage at 4C because of an unusually high pH brought about by the application of ammonia. (Moore-SRC)
W83-01469

AN INEXPENSIVE REMOTE SNOW-DEPTH GAUGE BASED ON ULTRASONIC WAVE REFLECTION FROM THE SNOW SURFACE,
Eidgenoessische Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
H. Gubler.
Journal of Glaciology, Vol 27, No 95, p 157-163, 1981. 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Measuring instruments, *Snow depth, *Ultrasonics, Snow, Snow cover, Snow density, Data acquisition, *Remote sensing.

An inexpensive system for measuring snow depth using only commercially available parts is described. Using this gauge the total snow depth is determined by measuring the time of flight of an

ultrasonic wave packet emitted from a sonic transmitter above the snow surface and reflected from the snow surface back to the receiver/transmitter system. The light-weight system is battery powered (operating time without battery change is at least 8 months) and can be fixed to any post above the snow surface. The absolute precision is better than + or - 0.03 m. Data and commands are transmitted by a single two-wire system up to several kilometers. The whole system consists of three parts: the field electronics including the sonic receiver/transmitter and the converter; the controls including the command structure, display, data storage, and binary coded decimal output; and the optional line drivers. The field electronics are fixed to a rod 2 m long parallel to the snow surface. This device, including the rod and a solar radiation reflector, has a weight of about 70 N. The field system may be fixed to any vertical post exceeding the maximum snow depth by about 0.6 m and having a strength able to withstand the extreme wind and snow forces. Installations are possible on slopes as well as on horizontal test fields. (Baker-FRC)
W83-01498

DETRITUS ABUNDANCE AND BENTHIC INVERTEBRATE CATCH IN ARTIFICIAL SUBSTRATE SAMPLES FROM MOUNTAIN STREAMS,
Geological Survey, Menlo Park, CA.
K. V. Slack, L. J. Tilley, and S. S. Hahn.
Water Resources Bulletin, Vol 18, No 4, p 687-698, August, 1982. 5 Fig, 7 Tab, 66 Ref.

Descriptors: *Sampling, Benthic environment, Streams, *Detritus, *Invertebrates, Mountains, *Artificial substrates, *Idaho, Salmon River.

Preliminary experiments to increase the effectiveness of artificial substrate samplers for use in water quality investigations are described. The study area was the upper drainage basin of the Salmon River in Custer County, south central Idaho. Artificial substrates were designed using rock filled polyethylene bags perforated with holes. The substrates trapped waterborne sediment and detritus which enhanced microhabitat complexity. Colonization was compared in side-by-side tests with multiple plate samplers in mountain streams ranging from second to seventh order. After 41 days the bag samples contained more sediment and detritus and more animals than did multiple plates. However, catch composition was similar in habitat preference and functional groups. The results support the conclusion that stream benthos abundance and diversity are related to the amount of detritus. Maximum diversity and numbers of individuals occurred in samples from third and fourth order streams. Grazers reached peak abundances in the same streams where the continuum model predicts P > R. Shredders reached maximum abundances in third and fourth order streams where the riparian canopy was greatest. Predator abundance changes little with stream size. Although bag samples required more sorting time, the samples are catch effective, inexpensive and adaptable. (Baker-FRC)
W83-01503

SENSITIVITY OF AN INFRARED GAS ANALYZER USED IN THE DIFFERENTIAL MODE, TO PARTIAL GAS PRESSURES OF CARBON DIOXIDE AND WATER VAPOR IN THE BULK AIR,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Agricultural Meteorology.
H. Z. Enoch, and Y. Cohen.
Agricultural Meteorology, Vol 24, No 2, p 131-138, June 1981, 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Water vapor, *Diurnal distribution, *Infrared spectroscopy, *Calibrations, Carbon dioxide, Vapor pressure, Sensitivity analysis.

Near plant communities there exists a diurnal variation in partial carbon dioxide (CO) and water vapor pressures which may affect the sensitivity of infrared gas analyzers (IRGA) used in the differential mode. The sensitivity of the instrument to differential CO pressure decreased linearly as partial CO pressure increased. This linear decrease in sensitivity was also demonstrated for water vapor IRGA used in the differential mode. An approved method for preparing calibration gases was used to determine the sensitivity of CO and water vapor IRGA instruments in terms of the electrical output per unit of specific gas pressure. The simple gas dilution technique used required only one commercially available temperature bath and a calibration gas-mixing pump. (Geiger-FRC)
W83-01693

A VOLUMETRIC LYSIMETER SYSTEM FOR USE WITH PUDDLED RICE AND ITS ROTATIONAL CROPS,
Meteorological Office, Poona (India).
S. Venkataraman, K. Subba Rao, and R. P. Sarker.
Meteorological Office, Poona (India).

Descriptors: *Lysimeters, *Rice, *Evapotranspiration, Water table, Instrumentation, Irrigated crops.

A volumetric lysimeter has been designed to measure evapotranspiration losses of puddled rice and its aerobic, irrigated rotational crops. The lysimeter consists of a field tank connected by an underground pipeline to a float mechanism which in turn is connected through a needle valve to a supply tank. For the rice crop measurements the float maintains the chosen water level. For aerobic crops the float is disconnected and excess water is drained out. The float is then reconnected to maintain the desired depth of water table, usually 60 cm. For rice evapotranspiration is given by the amount of inflow plus rain minus outflow. For aerobic crops irrigation is applied to just produce an outflow. Evapotranspiration is determined by inflow plus rain plus added irrigation water minus outflow. (Cassar-FRC)
W83-01698

7C. Evaluation, Processing and Publication

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1979-80,
Geological Survey, Austin, TX. Water Resources Div.
R. Perez.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $16.25, Microfiche $3.50. Geological Survey Open-File Report 82-158, February 1982. 125 p, 1 Fig, 8 Tab, 6 Ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, *Storm runoff, *Urban runoff, *Hydrologic data, Small watersheds, Streamflow, Flow rates, Flood peak, Flood profiles, Watershed management, *Texas, *San Antonio.

This report contains rainfall, runoff, and water-quality data collected during the 1979-80 water years for the San Antonio metropolitan area. The information will be useful in determining the effects of various stages of urbanization on flood discharge and runoff and in determining chemical constituents in surface-water runoff from floods of various magnitudes during all seasons of the year from areas with different types of urban development. Detailed rainfall-runoff computations are presented for several storm periods during the 1979-80 water years. (USGS)
W83-01402

HYDROLOGY OF LAKE TOHOPEKALIGA, OSCEOLA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. G. Phelps.
Geological Survey Open-File Report 81-536 (WRI), 1982. 2 Sheets, 8 Fig, 7 Tab, 11 Ref.

Descriptors: *Lakes, *Lakes morphology, *Water quality, *Data collections, Chemical analysis, Nutrients, Pesticides, Lake sediments, *Florida, Osceola County, *Lake Tohopekaliga, Kissimmee River.

Lake Tohopekaliga, one of the major lakes in central Florida, provides flood control in the upper Kissimmee River basin, recreation for fishermen and boaters, water for live-stock, esthetic surroundings for homesites, and serves as a receiving body for treated effluent from municipal sewage treatment plants. The purpose of this map report is to provide a general reconnaissance of the lake, based primarily on existing geologic, hydrologic and water-quality data. The lake has a surface area of about 30 square miles and a mean depth of about 5 feet. Maximum depth measured was about 13 feet. Inflow to the lake comes from Shingle Creek and St. Cloud canal and outflow is through the South-port canal. Regulation of lake levels for flood control began in the early 1960's and has resulted in a decrease in the range of lake stage of about 3 feet. Concentrations of pesticide residues in lake bottom sediments do not appear to have increased from 1972 to 1980. The lake has abundant aquatic vegetation, the amount and extent of which varies with fluctuating water levels. Water-quality data collected between 1954-77 are summarized in the report and additional data collected in 1980 are also shown. The range of plant nutrient concentrations measured in May 1980 are: Total organic nitrogen 0.71-2.2 milligrams per liter. Most water-quality parameters vary from one area of the lake to another because of restricted areal circulation due to the shape of the lake. (USGS)
W83-01405

MAPPING SOIL EROSION BY RAINFALL FOR REGIONAL ENVIRONMENTAL PLANNING,
Sheffield Univ. (England). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W83-01412

A GROUNDWATER RESOURCES DATABANK IN THE KINGDOM OF SAUDI ARABIA,
MacDonald and Partners, Cambridge, England.
J. M. Marsh, I. Sagaby, and R. R. Sooley.
Journal of the Geological Society, Vol 138, Part 5, p 599-602, September, 1981. 1 Fig, 3 Tab, 1 Ref.

Descriptors: *Data storage and retrieval, *Water supply development, *Groundwater management, *Water resources development, Data acquisition, Data collections, *Saudi Arabia, Water management, Computers, Information retrieval, Information systems, Data processing.

In rapidly developing countries, one of the chief impediments to efficient assessment and planning of the use of geologic resources is the frequent lack of awareness of existing data and difficulty in accessing available information. Such problems can be reduced by employing a computerized data storage and retrieval system. Such a system is being implemented by the Water Resources Development Department and Ministry of Agriculture and Water, Saudi Arabia, to store data on water resources and hydrogeology. The lack of an adequate system of data storage has impeded rationalization and adjudication of existing data. To enable the introduction of sophisticated data processing techniques, all available data are being input to a multiple data base. So far only the well site data file has been implemented, and details of 23,000 wells have been entered into the file. A further 6 files are planned to cover all aspects of water resources, and the hydrochemistry and surface water data files are now in preparation. The data are managed by SYSTEM 2000 software loaded on an IBM 370/158 computer housed in the National Computer Center. An example of some codes and element descriptions for a data bank are given using the groundwater database as an example. (Baker-FRC)
W83-01499

FLOOD PEAKS AND DISCHARGE SUMMARIES IN THE DELAWARE RIVER BASIN,
Geological Survey, Trenton, NJ. Water Resources Div.
A. A. Vickers, H. A. Farsett, and J. W. Green.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $39.75 in paper copy, $3.50 in microfiche. Geological Survey

Open-File Report 81-912, 1981. 292 p, 2 Fig, 17 Ref.

Descriptors: *Flood peaks, *Flood discharge, *Data collections, *Historic floods, Streamflow, Runoff, Gaging stations, Sites, *Delaware River basin, New Jersey, New York, Pennsylvania, Delaware.

This report contains streamflow data from 299 continuous and partial-record gaging stations in the Delaware River basin. The location, drainage area, period of record, type of gage, and average flow (discharge) is given for each continuous station. Also included, are annual flood peak discharges and discharges above a selected base, annual and monthly mean discharges, and annual and monthly runoff. (USGS)
W83-01509

HYDROLOGIC INVESTIGATIONS AND DATA-COLLECTION NETWORK IN STRIPPABLE COAL AREAS IN NORTHWESTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
H. R. Hejl, Jr.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-358, January 1982. 32 p, 5 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, *Coal mining, Data collections, Streamflow, Water quality standards, Gaging stations, Observation wells, *New Mexico, San Juan Basin.

This report presents hydrologic investigations and data collections conducted by the U.S. Geological Survey in the strippable coal areas of northwestern New Mexico. Streamflow, ground-water, and quality-of-water data were collected to provide information about baseline or prevailing hydrologic conditions. A network of hydrologic data-collection sites in the strippable coal areas of the Fruitland Formation was designed to meet the need of detailed investigations, including site-specific studies, and to provide hydrologic data in support of the expanding mining activity. The network consists of 34 continuous-record streamflow-gaging stations (32 included water-quality sampling), 20 miscellaneous water quality of streamflow stations, 12 annual maximum discharge stations, 27 observation wells completed in strata associated with the strippable coal seams, and 24 observation wells completed in channel alluvium downstream from strippable coal areas. (USGS)
W83-01510

SUMMARY OF GROUND-WATER AND SURFACE-WATER DATA FOR CITY OF PENSACOLA AND ESCAMBIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. E. Coffin.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $ 17.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-361, 1982. 131 p, 11 Fig, 11 Tab, 20 Ref.

Descriptors: *Groundwater, *Surface water, *Wqter quality, *Data collections, Available water, Streamflow, Wells, Lithologic logs, Chemical analysis, Water analysis, Nutrients, Trace elements, *Florida, Escambia County, Pensacola.

Hydrologic, geologic, and water-quality data collected in Escambia County, Florida, October 1962 through September 1980 are presented. The data were collected by the U.S. Geological Survey as part of a cooperative investigation with the city of Pensacola and Escambia County to provide information on the quality and quantity of water available from the sand-and-gravel aquifer and selected surface-water sites in Escambia County. Groundwater data include records of 440 wells, chemical and physical analyses of water quality for 325 wells, 6 long-term hydrographs, and 19 lithologic logs. Surface-water data include streamflow measurements and analyses of water collected at 9 sites. Maps of the county show the locations of the data-collection sites. (USGS)
W83-01511

CHEMICAL AND PHYSICAL CHARACTERISTICS OF WATER IN ESTUARIES OF TEXAS, OCTOBER 1976-SEPTEMBER 1978,
Geological Survey, Austin, TX. Water Resources Div.
J. C. Fisher.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $30.50 in paper copy, $5.00 in michrofiche. Geological Survey Open-File Report 82-354, August 1982. 213 p, 14 Fig, 10 Tab, 14 Ref.

Descriptors: *Chemical properties, *Physical properties, *Water quality, *Esturaries, *Data collections, Sampling, Sites, Water analysis, Chemical analysis, Organic compounds, Inorganic compounds, Trace elements, Nutrients, Insecticides, Bacteria, Coliforms, Chlorophyll, *Texas.

This report presents basic data on the chemical and physical characteristics of water in the estuaries of Texas for the period October 1976-September 1978. The properties or constituents that are measured in the field are dissolved oxygen (DO), specific conductance, temperature, pH, and transparency by Secchi disk. Analyses conducted in the laboratory include the principal inorganic ions, biochemical oxygen demand (BOD), total organic carbon (TOC), ammonium, nitrite, nitrate, and total phosphate. (USGS)
W83-01514

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1978-82,
Geological Survey, Lakewood, CO. Water Resources Div.
J. L. Blattner, and B. D. Rasmuson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-573, 1982. 28 p, 2 Fig, 1 Tab.

Descriptors: *Water level, *Wells, *Aquifers, *Well data, Sites, Elevation, Water level fluctuations, Water Management, *Colorado, Northern High Plains, Ogallala Formation.

Water-level measurements were made in 674 wells during the winter of 1981-82 in the northern High Plains of Colorado. The water-level measurements for the winter of 1981-82 and the four preceding winters are given in a table. This table also contains the location, depth, land-surface elevation, and the aquifer of each well. (USGS)
W83-01515

ARSENIC, NITRATE, IRON, AND HARDNESS IN GROUND WATER, CHENA HOT SPRINGS ROAD, STEELE CREEK ROAD, AND GILMORE TRAIL AREAS, (T.1N., R.1E., FM), FAIRBANKS, ALASKA,
Geological Survey, Fairbanks, AK. Water Resources Div.
A. P. Krumhardt.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price $3.50 in paper copy, $1.00 in microfiche. Geological Survey Open-File Report 82-356, 1982. 2 Sheets, 2 Ref.

Descriptors: *Water quality, *Groundwater, *Wells, *Iron, *Hardness, *Arsenic, *Nitrates, Water analysis, Chemical analysis, Water pollution, Contamination, Public health, Maps, *Alaska, Fairbanks.

This report presents all data on arsenic, nitrate, iron, and hardness in well water in the Chena Hot Springs Road, Steele Creek Road, and Gilmore Trail area of Fairbanks, Alaska, collected through October 1981. Concentrations range as follows: arsenic - 0 to 5,100 micrograms per liter; nitrate - 0 to 53 milligrams per liter; iron - 0 to 50 milligrams per liter, and hardness - 12 to 1,000 milligrams per liter. The percentage of samples exceeding limits set by the U.S. Environmental Protection Agency are as follows: arsenic - 13%; nitrate - 14%, and iron - 80%. (USGS)
W83-01516

DRAINAGE AREAS OF NEW YORK STREAMS, BY RIVER BASINS--A STREAM GAZETTEER: PART I--DATA COMPILED AS OF OCTOBER 1980,
Geological Survey, Albany, NY. Water Resources Div.
L. A. Wagner.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $51.00 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-1055 (WRI), 1982. 359 p, 3 Fig, 1 Plate, 1 Tab. 1 Ref.

Descriptors: *Hydrologic data, *Surface water, *Drainage area, *Streams, *River basins, Runoff, Sites, *New York.

Hydrologic studies concerned with surface water require geographic data of several types, among which are stream length and size of drainage area from which runoff is contributed. This gazetteer presents all drainage-area data on New York streams that were available as of October 1980. The information is grouped by river basin, and each section consists of two lists. The first gives sites alphabetically by stream name and includes the body of water to which the stream is tributary, county in which the site is located, drainage area above the mouth, coordinates of the topographic quadrangle on the State index map, and the Geological Survey site number. The second list presents site information by U.S. Geological Survey site number (downstream order along the main stream) and includes drainage area, distance of measurement site above the mouth, and location by latitude and longitude. Data were compiled from published and unpublished sources, all of which are available for inspection at the U.S. Geological Survey in Albany, N.Y. Also included are updated values on several river basins that have been redelineated and whose drainage areas have been recomputed and retabulated since 1977. (USGS)
W83-01519

WATER RESOURCES DATA, COLORADO, WATER YEAR 1981. VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN.
Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Water-Data Report CO-81-3, 1982. 436 p, 6 Fig, 4 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Surface water *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Dolores River basin, Green River basin, San Juan River basin.

Water-resources data for Colorado for the 1981 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations; stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W83-01522

STORAGE AND RETRIEVAL OF GROUND-WATER DATA AT THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
M. W. Mercer, and C. O. Morgan.

Available from Br. of Distr. 604 S. Pickett St. Alexandria, VA 22161. Geological Survey Circular 856, 1982. 9 p, 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Data storage and retrieval, *Groundwater, *Data collections, *Water management, Sites, Wells, Springs, Water level, Networks, Well data, Hydrographs, *U.S. Geological Survey, *Groundwater Site-Inventory Data Base, NAWDEX, WATSTORE, SYSTEM 2000.

The U.S. Geological Survey maintains a computerized Ground-Water Site-Inventory (GWSI) file that contains information about wells and springs at sites from all States of the United States. This file contains data collected by U.S. Geological Survey personnel and personnel of cooperating State, local and Federal agencies. The file is easily accessible to members or users of the National Water Data Exchange. Since the establishment of the GWSI file in 1974, the data base has grown 19% per year and contains information on about 770,000 sites as of February 1981. (USGS)
W83-01523

WATER-LEVEL DATA FOR WELLS IN BURIAL GROUND 5, OAK RIDGE NATIONAL LABORATORY, TENNESSEE, 1975-1979,
Geological Survey, Knoxville, TN. Water Resources Div.
D. A. Webster, J. S. Beatty, P. M. Benjamin, and W. M. Tranum.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO. 80225, Price: $19.50 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 82-372, 1982. 135 p, 1 Plate, 2 Tab.

Descriptors: *Data collections, *Water level, *Wells, *Well data, Observation wells, Water level fluctuations, Water measurement, Sites, Solid waste disposal, Radioactive waste disposal, Hydrographs, *Tennessee, Oak Ridge National Laboratory, Burial grounds.

Data pertaining to wells in and near Burial Ground 5 at Oak Ridge National Laboratory, Tennessee, is presented for the period 1975 to 1979. It includes an inventory of wells, measuments of water levels, well hydrographs, and a map showing the location of the wells. (USGS)
W83-01524

WATER RESOURCES DATA, SOUTH CAROLINA, WATER YEAR 1981.
Geological Survey, Columbia, SC. Water Resources Div.
Geological Survey Water-Data Report SC-81-1, 1982. 336 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *South Carolina.

Water resources data for the 1981 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 85 gaging stations, stage-only records for 6 gaging stations, stage and contents for 11 lakes and reservoirs, water quality for 36 gaging stations, and water levels for 47 observation wells. Also included are 44 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (USGS)
W83-01525

URBAN RAINFALL-RUNOFF-QUALITY DATA BASE,
Florida Univ., Gainesville.
W. C. Huber, J. P. Heaney, D. A. Aggidis, R. E. Dickinson, and K. J. Smolenyak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-221094, Price codes: A23 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-238, July 1982. Municipal Environmental Research Laboratory, Cincinnati, Ohio. 5 p, 1 Fig, 1 Tab.

Descriptors: *Rainfall-runoff relationships, *Water quality, *Urban runoff, *Data collections, Storm runoff, Urban hydrology, Pollution load, Catchment areas, Runoff volume, Rainfall rate.

A common and basic need for mathematical models of urban hydrologic processes is for adequate data with which to calibrate and verify them. Such models are being used in many applications and the need for relevant data has intensified. An equally important data requirement arises from the need to characterize urban stormwater discharges and combined sewer overflows. Since 1974 EPA has supported the urban rainfall-runoff-quality data base with these needs in mind. The data base project, conducted by the University of Florida, was initiated to bring together in a consistent and accessible format the many data sources found in unpublished documents widely scattered throughout various firms, universities, and government agencies. Urban rainfall-runoff-quality data have been assembled on a storm event basis for 48 catchments in 16 urban areas. Urban hydrologic data without quality data have been assembled for an additional 25 catchments in 15 urban areas. Statistical analysis and descriptions of the catchments, parameters and sampling procedures are provided in the data base reports. For each storm event, the clock times, and the duration and volume of rainfall and runoff are given. For quality parameters, ranges, flow-weighted means, standard deviations, and loadings (i.e., pounds per acre-inch of runoff) are provided on an average basis across all events for each catchment. The same statistics are available for individual storm events on the data base magnetic tape. Actual data are on the magnetic tape and on the EPA STORET data retrieval system.
W83-01569

DEVELOPING A NEW DECONVOLUTION TECHNIQUE TO MODEL RAINFALL-RUNOFF IN ARID ENVIRONMENTS,
Arizona Univ., Tucson, Dept. of Hydrology and Water Resources.
S. P. Neuman, S. D. Resnick, and R. W. Peebles.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150318, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1982. 7 p, 1 Fig, 7 ef. OWRT A-086-ARIZ(1), 14-34-0001-8003.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, Simulation, Arid climates, Error analysis.

Noisy rainfall-runoff records of short duration are encountered in arid environments where rainfall often occurs in short isolated bursts and the data are measured with a considerable margin of error. Known noise was superimposed on synthetic rainfall-runoff data to examine the ability of the Neuman-de Marsily deconvolution method to estimate the correct impulse response of the system when the data include only a single storm event. Approximately 50 Monte Carlo simulation runs were performed for each of three different noise models. The results clearly demonstrated that the deconvolution model leads to reliable estimates can be used with confidence in the presence of realistic noise levels. In addition to the Monte Carlo simulation tests and their analysis, certain improvements were introduced into the original deconvolution technique. The original version of the technique required that the hydrologist exercise subjective judgement in choosing the best solution for the deconvolution problem from a large number of admissible solutions. The new method of selecting the best result is based on a comparative analysis of residuals and is more reliable than the earlier subjective approach. The improved method has been applied to real as well as synthetic rainfall-runoff data. (Moore-SRC)
W83-01627

BEWARE OF SPURIOUS SELF-CORRELATIONS,
Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
B. C. Kenney.
Water Resources Research, Vol 18, No 4, p 1041-1048, August, 1982. 8 Fig, 16 Ref.

Descriptors: *Correlation analysis, *Regression analysis, *Mathematical studies, Spurious self-correlation, Graphical analysis, Statistics, Data processing, Hydraulics, Hydrology.

Spurious self-correlations arise when two parameters (sums, differences, ratios, products, or single variables) used in a linear regression analysis have some element in common. To illustrate this, perfect but spurious correlations between two such parameters are produced with random numbers. The largest magnitude of spurious self-correlation coefficient occurs for data sets where there is much greater dispersion in the data for the common term relative to the unique terms in the parameters. Logarithmic transformations or log-log plots enhance spurious self-correlations of ratios and products. Several examples of spurious self-correlations in the literature are given as examples: Vollenweider (1976), a plot of a sedimentation constant vs. mean depth of lakes; Bell et al. (1980), the ralationship between the coefficient of variation of soil moisture and the mean soil moisture; Morgan (1980), a relationship between weight-specific epiphyte assimilation rate and shrimp weight; and Bamstedt and Skjoldal (1980), RNA weight in zooplankton divided by the dry weight of the specimens plotted against the dry weight of the specimens. In these illustrations ratios have been plotted against their own denominators. (Cassar-FRC)
W83-01713

8. ENGINEERING WORKS

8A. Structures

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
Yu. D. Gavrilyuk, A. G. Mel'nikov, A. A. Sirotkin, and A. V. Shlychkov.
Hydrotechnical Construction, Vol 15, No 11, p 706-711, May, 1982. 4 Fig, 5 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 42-46, November, 1981.

Descriptors: *Dam stability, *Seepage lines, *Monitoring, *Observation wells, *Mathematical studies, Dam construction, Dam design, Reservoirs, Seepage, Drains, Water temperature, Sand, Graphical analysis, Angara River, *USSR, Hydroelectric plants.

The operation of the Ust-Ilim hydroelectric station dam on the Angara River was monitored using 52 piezometric wells, 27 surface geodetic markers, 4 deep geodetic markers, and gauging sites in drain No 2. Results of the first years of observations of the seepage regime of the right-bank sand dam of the Ust-Ilim hydrostation showed that the process of seepage through the dam has not yet become stabilized. This is revealed in the increase of seepage discharges with time and the gradual decrease of the level of the seepage line in the dam causing an increase in the seepage velocity. Observations of the temperature of the seepage water in the drainage systems of the hydrostation with simultaneous measurement of the water temperature vertically in the reservoir allowed approximations of the travel time of the temperature wave from the reservoir through the dam to the drains. Further systematic observations of seepage through the right-bank sand dam of the hydrostation are needed to prevent the possible development of piping processes. (Geiger-FRC)
W83-01536

8B. Hydraulics

VERTICAL TURBULENT DIFFUSION IN AIR-DRIVEN WATER FLOWS,

Technische Hogeschool, Delft (Netherlands).
L. H. J. Goossens, H. J. A. van Pagee, and P. J. Tessel.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY9, p 995-1009, September, 1982. 10 Fig, 4 Tab, 22 Ref.

Descriptors: *Diffusion coefficient, *Mixing, *Air-water interfaces, Shear stress, Wave action, Aeration, *Reynolds number, *Turbulent flow, Boundary layers, Eddy diffusion.

The turbulence and Reynolds stresses produced in a water channel by an air flow over the surface were measured in a laboratory water tank. An expression was derived for the vertical eddy diffusion coefficient, which is important in deciding under what circumstances artificial mixing is needed. The drag necessary for the creation of waves and the development of a boundary layer, including the acceleration of the water mass, was significant. Horizontal velocities showed logarithmic drift profiles in the upper boundary profile with a deviation in the near surface region (1.5 cm depth at a wave height of 0.2-0.4 cm). This deviation was a result of incomplete energy transfer from waves to the boundary layer in the near surface region. A linear shear stress distribution and Prandtl mixing length increase were measured within the boundary layer, allowing the use of a two-dimensional theory even though the flow field was not strictly two-dimensional. These results are applicable to larger lakes and reservoirs if no vertical density gradient is present. (Cassar-FRC)
W83-01532

DISCHARGE ASSESSMENT IN COMPOUND CHANNEL FLOW,

Queen Mary Coll., London (England).
P. R. Wormleaton, J. Allen, and P. Hadjipanos.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No NY9, p 975-994, September, 1982. 11 Fig, 2 Tab, 21 Ref.

Descriptors: *Discharge capacity, *Channel flow, *Shear stress, Flood plains, Open-channel flow, Hydraulics, Hydraulic roughness.

The boundary shear stresses in a laboratory compound channel (main channel and associated shallow flood plains) were measured. Four roughnesses were used: smooth concrete and roughening of the channel with 6 mm diameter concrete hemispheres to Manning's n of 0.014, 0.017, and 0.021. A statistical relationship between the apparent shear stress on the vertical interface and several easily calculated parameters of the channel geometry and hydraulic characteristics was derived. Apparent shear stresses acting on vertical interface planes were strongly related to velocity differences between adjacent subdivisions, depth ratio, and width ratio. At low flood plain depths the apparent shear stresses across the vertical interface planes were much higher than main channel boundary shear stresses and increased with greater flood plain roughness. Apparent shear stresses across horizontal and diagonal interface planes were much smaller than those for the vertical planes; they were always less than the main channel boundary shear stresses. At increased flood plain depth the apparent shear stress decreased and sometimes changed sign. The accuracies of several methods of calculating channel discharge capacity were dependent on assumptions regarding the magnitude of the apparent shear stress on the particular interface chosen. The apparent shear stress ration was a dominant factor in determining the tendency of a method to underestimate or overestimate channel discharge capacity. Generally at lower flood plain depths, use of the horizontal or diagonal interfaces gave better discharge results than using the vertical interface. (Cassar-FRC)
W83-01533

TRANSIENT CONDITIONS IN THE TRANSITION FROM GRAVITY TO SURCHARGED SEWER FLOW,

Windsor Univ., (Ontario). Dept. of Civil Engineering.
M. A. Hamam, and J. A. McCorquodale.

Canadian Journal of Civil Engineering, Vol 9, No 2, p 189-196, June, 1982. 10 Fig, 9 Ref.

Descriptors: *Transition flow, *Pressure head, *Sewers, Sewer systems, Sewer hydraulics, Gravity flow, Flow, Fluid mechanics, Hydrodynamics, Pipes, Pipe flow, Pipelines, Surges.

One of the least understood aspects of flow in sewers is the nature of the transition from gravity to pressure or surcharged flow. This study examined the transition from gravity to surcharged flow due to a rapid decrease in the flow capacity at some point in the sewer. A particular example of such a rapid decrease would be the failure of an outfall pump. Formulas are suggested for determining the severity of pressure transients. An experimental study of the formation of surges in sewers and the associated transient (water hammer) pressures was carried out. The hydraulic model studies confirmed that transient pressures can occur in sewers during the transition of gravity to surcharged flow. The transition from gravity to pressure or surcharged flow is shown to be a two-phase phenomenon. The instantaneous pressure head associated with the transition of open-channel to surcharge flow in sewers can exceed the hydraulic grade line for full pipe flow by several times the pipe diameter. In a prototype sewer, pressures of the order of 40 m are possible. Negative pressures were also recorded in a few tests. An abrupt transition creates the most severe pressure fluctuations. Other factors affecting the pressure transients include pipe size, pipe shape, flow velocity, Froude number, relative depth, alignment of the pipe, pipe material, venting arrangements, and boundary conditions such as pumps, interceptors, and drop-pipes. (Baker-FRC)
W83-01541

SELF-AERATED FLOW IN STEEP, PARTIALLY FILLED PIPES,

Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
P. U. Volkart.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY9, p 1029-1046, September, 1982. 16 Fig, 23 Ref.

Descriptors: *Pipe flow, *Air entrainment, Wastewater treatment, *Aeration, Conduits, Flow pattern, Hydraulics, Flow velocity, Air-water interface, Bubbles, Turbulent flow, Closed-conduit flow.

The entrainment of air bubbles in steep, partially-filled circular conduits was investigated in pipelines with slope angles of 1-45 degrees, inner diameters of 110-900 mm, water discharges of 1.5-1930 liters per sec, and different wall roughnesses. This mechanism has been applied in aeration and treatment of wastewater in mountainous regions. For small and middle depth to diameter ratios the isotachs were analogous to those of water on mild conduit slopes. The velocity increased from top to bottom with the maximum in the plane of symmetry just below the free surface. Contour lines of air concentration were generally parallel to the free surfaces of the mixture. The nature of isotachs and air concentration contour lines indicates that bubble entrainment takes place through the free surface. For slopes < 45 degrees, smaller air concentrations were obtained in a partially filled circular tube than in an open rectangular channel. For large diameter smooth pipes air bubbles began to form at lesser slopes than for small, rough pipes. Formulas were derived for the mean air concentration, mean mixture velocity, and the critical slope that initiates air entrainment. Equations were also applied to conduits of elliptical or rectangular shape. (Cassar-FRC)
W83-01547

MODELLING SIDE-WEIR DIVERSION STRUCTURES FOR STORMWATER MANAGEMENT,

McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W83-01555

PREDICTION OF CHANNEL DEFORMATIONS OF RIVERS AND CANALS,

V. S. Altunin, and L. I. Baganova.

Hydrotechnical Construction, Vol 15, No 11, p 698-705, 1981-1982. 2 Fig, 4 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 37-41, November, 1981.

Descriptors: *Deformation, *Channel flow, *Channel morphology, *Mathematical studies, *Canals, *Graphical analysis, *Mathematical models, Canal design, Rivers, Graphical methods, Model studies, River flow, Kara-Kum Canal, *USSR.

The boundaries between types of the channel-forming process according to data of various authors are compared. The conditions of formation of the river runoff and graphs of the passage of the design water discharges in a canal are quite different. Canals differ from natural rivers by artificial cross-sectional shapes of the channel and water regime. The type of channel-forming process on morphologically homogeneous stretches was determined with the use of large-scale maps. Graphical analysis showed that freely meandering rivers have a maximum nonuniformity of runoff, rivers with a predominance of short-circuited meandering have smaller nonuniformity of runoff, and rivers with a multiple-braided floodplain and channel condition have a still smaller nonuniformity coefficient. The majority of unlined canals of the Amu Darya basin are stable. To select a stable channel shape it is necessary to determine the direction of channel deformations. Types of channel forming processes were determined for the Kara-Kum canal in stretches composed of fine sand, loamy sand, and loamy clay. Morphometric relationships were proposed for determining the width and average depth as a function of the dominant discharges in rivers and large unlined canals. These relationships can be used to calculate the main dimensions of the regulated stretch of a river with a certain type of channel-forming process and assign the appropriate mean velocity of the flow. (Geiger-FRC)
W83-01556

8C. Hydraulic Machinery

ANALOG MODEL AND EVALUATION OF THE FOUNTAIN VALLEY RATE-OF-FLOW CONTROL STATION,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. A. Skiles, and W. B. Gish.

Report REC-ERC-82-10, October 1981, 57 p, 12 Fig, 2 Ref, 2 Append.

Descriptors: *Automation, *Computers, *Control systems, *Pipelines, *Computer Models, *Pumping plants, Water conveyance, Water hammer, Model studies, Pipe flow, Flow control, *Colorado, Fountain alley Conduit.

The Fountain Valley Conduit is a 45-mile pipeline constructed to deliver water from Pueblo Dam north to the cities of Colorado Springs, Stratmoor Hills, Fountain, and Widefield, Colorado. A computer based supervisory control system will control five pumping plants along the pipeline and a rate-of-flow control station (RFCS) to regulate waterflow. An analog computer model was designed to represent the RFCS and evaluated to determine system performance. The remote control of pipe valves was studied to ensure the system's operation would not rupture the pipes. Because the storage tank cannot hold all the water in the pipe, the controller must ensure the tank will not overflow. These requirements occasionally require conflicting control functions. Based on this model study, the specified method of regulating

terminal tank level, using a remote terminal unit actuated RFCS is expected to perform adequately. System response to transient pipe behavior is slow and substantially attenuated by large system energy transfer capacities. Proportional-integral values are critical to flow-path-control stability. (Moore-SRC)
W83-01448

8D. Soil Mechanics

THE PERFORMANCE OF IMPERMEABLE AND PERMEABLE REINFORCEMENT IN CLAY SUBJECT TO UNDRAINED LOADING,
Ground Engineering Ltd., Boreham Wood (England).
T. S. Ingold, and K. S. Miller.
Quarterly Journal of Engineering Geology, Vol 15, No 3, p 201-208, 1982. 5 Fig, 7 Tab, 5 Ref.

Descriptors: *Load distribution, *Drainage engineering, *Permeability, Reinforcement, Clays, Pore water, Soil types, Leaching, Soil mechanics, Hydraulic loading.

During the rapid loading of clay soils there is often no opportunity for the dissipation of any pore water pressure that may be generated. The response of reinforced clay to undrained loading will be a function of the nature of the reinforcement. To investigate the possible responses a pilot study was undertaken using two different reinforcing materials. These were installed in cylindrical clay samples which were subject to either rapid shear or shear at constant volume, both of these regimes being consistent with the notion of undrained loading. It was found that impermeable reinforcement in the form of aluminum foil caused a consistent and substantial decrease in strength compared to that of an unreinforced sample. For clay reinforced with porous plastic reinforcement the strength of the soil improved as reinforcement spacing decreased and ultimately exceeded that of the unreinforced clay. This response reflected the fact that rapid loading is not necessarily associated with undrained loading if the reinforcement, which also acts as a drain, is installed at a sufficiently small spacing. In truly undrained tests, where constant volume conditions are imposed, a strength decrease was anticipated. That this was not the case is thought to be due to the low pore water pressure response of the reinforcement, which has the effect of depressing the otherwise high deleterious pore water pressure generated in the clay. (Baker-FRC)
W83-01500

8I. Fisheries Engineering

IMPACT OF A ONCE-THROUGH COOLING SYSTEM ON THE YELLOW PERCH STOCK IN THE WESTERN BASIN OF LAKE ERIE,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen.
Ecological Modelling, Vol 15, No 2, p 127-144, March, 1982. 10 Fig, 3 Tab, 20 Ref.

Descriptors: *Entrainment, *Powerplants, *Perch, *Cooling water, Hydroelectric plants, *Lake Erie, Model studies, Biomass, Fish, Fisheries, Lake fisheries, Fish eggs, Larvae.

A conventional fishery stock assessment model, the surplus production model, was applied to evaluate the impact of entrainment and impingement at the Monroe Power Plant on the Yellow perch standing stock and fishery in the western basin of Lake Erie. The biological parameters of the model are obtained from commercial catch and effort data, while entrainment and impingement coefficients are calculated from powerpalnt data. The model is used to predict the stock biomass and egg larva production data from which the proportions of impinged and entrained individuals are estimated. The effects of water withdrawal are simulated. The impact of the Monroe Power Plant was found to be relatively small; it reduced biomass and the maximum sustainable yield of the yellow perch stock by only a few percent. Since there are other power-plants impacting the yellow perch stock of the western basin of Lake Erie, it is suggested that their combined impact be examined. (Geiger-FRC)
W83-01416

WATER FLOW CONTROLLER,
Research Station for Salmonids, Sunndalsora (Norway).
B. P. Kinghorn.
Progressive Fish-Culturist, Vol 44, No 1, p 48-49, January, 1982. 2 Fig.

Descriptors: *Flow measurement, *Flow control, Aquaculture, Measurement, *Cisterns, Salmonids.

A cistern-based water controller was designed for measurement and control of water into fish tanks. The water supply is directed into a cistern (or blanked off polyvinyl chloride tube) which contains a tube with an overflow port. Large changes in flow rate can be adjusted by changing the screw-on outlet cap. Fine adjustments may be made by changing the level of the overflow port. (Cassar-FRC)
W83-01447

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

INFORMATION DISSEMINATION TECHNIQUES: CURRENT PRACTICES OF WATER INSTITUTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg, Water Resources Research Center.
K. E. Gill, and W. R. Walker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150235, Price codes: A06 in paper copy, A01 in microfiche. Report, January 17, 1980, 121 p, 2 Fig, 4 Tab, 44 Ref, 8 Append. OWRT B-059-VA(1), 14-31-0001-4137.

Descriptors: *Information exchange, *Water resources institutes, *Public relations, *Education, Publications, Newsletters, Information dissemination, Mass media.

A systematic approach to the task of information dissemination is set forth in this handbook, which was prepared primarily for water center directors. Information dissemination encompasses the use of such media as newspapers, television and radio, annual and interim reports, educational activities, and workshops and conferences. A questionaire was developed in order to assess the current state of information dissemination activities in water centers throughout the country. The survey results reveal diversity among water center activities. Only 20 of the 54 water centers currently employ an information specialist. Newspapers were the most-often used mass medium, with 68% of the centers reporting some use of newspapers. Thirty water centers indicated that radio was used in information dissemination. Television was used by 42%. Only 28 of the 54 centers produced a newsletter. All water centers publish an annual report, and over 50% produced research bulletins and brochures. Most water centers reported using slides in their information dissemination program, while only 14 of 54 indicated that films or videotape were used. Case studies, which illustrate the application of the information dissemination theory and tools outlined in this handbook, provide details of specific methods used by the water centers. (Moore-SRC)
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SELECTED WATER RESOURCES ABSTRACTS

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AT URBANA-CHAMPAIGN

VOLUME 16, NUMBER 6
JUNE 1983

W83-01751 -- W83-02100
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AT URBANA-CHAMPAIGN

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 16, NUMBER 6
JUNE 1983

W83-01751 -- W83-02100

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

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Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

ADSORPTION OF METAL IONS AND METAL COMPLEXES ON CLAY MINERALS: A STUDY OF THE NATURE OF BONDING BY X-RAY PHOTOELECTRON SPECTROSCOPY,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
J. G. Dillard, A. B. Emerson, M. H. Koppelman, D. L. Crowther, and C. V. Schenck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167882, Price codes: A10 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Completion Report, September 1982. 148 p, 30 Fig, 31 Tab, 118 Ref. OWRT B-119-VA(1).

Descriptors: *Bonding, Metals, *Metal ions, Metal ion complexes, Oxidation, *Spectroscopy, *X-ray photoelectron spectroscopy, Electrochemistry, *Clay minerals, *Surface chemistry, Chemical analysis, Chemical properties, Adsorption, Solids contact processes, Physicochemical properties, *Electrophoresis, Solid surfaces, Lead, Cobalt, Kaolinite, Nickel, Copper.

Results are reported of an investigaton of the interaction of metal ions, metal ion complexes, and organic ligands with mineral and metal ion-saturated surfaces. Minerals studied include those with oxidizing and nonoxidizing surfaces (for example, lead, cobalt, kaolinite, nickel, copper), selected as being typical of those with which metal ions and organic-metal complexes would interact. The purpose was to provide detailed chemical descriptions of the nature of the surface species. Surface characterization includes x-ray photoelectron spectroscopy, electrophoretic mobility, and infrared and visible spectroscopy. Results describe the chemical oxidation state of the adsorbed metals, the chemical stoichiometry of the surface adsorbates, and the chemical nature of the adsorbed ions. Evidence indicates that metal complexes interact with clay mineral surfaces via dissociative hydrolytic process. On the other hand, metal ion and metal ion complexes are oxidized when adsorbed on the MnO2 surface. Probable reactions processes for the dissociative hydrolytic processes are presented.
W83-02058

2. WATER CYCLE

2A. General

WASTEWATER SIMULATION MODEL FACES TOUGHEST TEST.
World Water, Vol 5, No 9, p 56-57, September, 1982. 1 Fig.

Descriptors: *Model studies, *Wastewater, *Simulation, Computers, SESIM, *Federal Republic of Germany, Hamburg, Pollutant identification, Water levels, Surface runoff, Hydrographs, Storms, Storm runoff.

A storm/wastewater management mode, SESIM, has been used to compute and simulate discharge in sewer systems since 1973 in Hamburg, Germany. SESIM is a hydrodynamic simulation model with an algorithm in the transport model which completely solves Barre de Saint Venant's equations for impulse and continuity. The first model, RUNOFF, covers the surfaces of urban areas such as roads, roofs, pavements and lawns, excluding backwater effects. The following hydrographs for each catchment area can be calculated: surface runoff as a result of a natural storm event or a storm model, dry weather flow, and hydrograph of pollution load. The hydrodynamic part of the drainage simulation is based on a configuration of junctions and branches, the junctions being manholes and the branches, pipes. Within the system, discharge is computed for a chosen time interval, and the following hydrographs are computed: water levels in a manhole, discharges, velocities, and concentrations of pollutants. (Baker-FRC)
W83-01840

DISTRIBUTED MODEL FOR SMALL SEMIARID WATERSHEDS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
L. J. Lane.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1114-1131, October, 1982. 5 Fig, 3 Tab, 34 Ref.

Descriptors: *Semiarid lands, *Flood frequency, *Hydrographs, Rainfall-runoff relationships, Model studies, Runoff, Peak discharge, Ephemeral streams, *Watersheds, *Arizona, Kansas, Nebraska, Texas.

A model for estimating runoff volumes and peak rates of flow from small semiarid watersheds was developed and tested on data from watersheds in Arizona, Kansas, Nebraska, and Texas. It is a compromise between physically based deterministic models and simplified procedures. The completed model was tested on data from 10 experimental watersheds in Arizona, representing over 260 rainfall-runoff events. Model results agreed well with observed results. It can also be used to predict water yield to a surface water balance incorporating transmission losses in ephemeral stream channels. Input parameters were obtained from maps, field measurements, handbooks, and other sources. Sensitivity of peak discharge for mean annual flood was significant for runoff curve number and rainfall depth, moderate to significant for watershed geometry, and moderate for channel geometry, hydraulic conductivity, and hydrograph shape parameters. (Cassar-FRC)
W83-01920

PHYSICAL CONSIDERATIONS IN THE ANALYSIS AND SYNTHESIS OF HYDROLOGIC SEQUENCES,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W83-01956

A DESIGN-DISCHARGE CALCULATION METHOD BASED ON THE PARALLEL USE OF RESERVOIR MODELS,
Louvain Univ. (Belgium). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W83-02017

HYDROLOGIC SERIES GENERATION FROM THE SPECTRAL DENSITY FUNCTION,
Utah Water Research Lab., Logan.
R. V. Canfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167981, Price codes: A03 in paper copy, A01 in microfiche. Utah Water Research Laboratory Hydraulic and Hydrology Series H-82/04, November 1982. 27 p, 8 Fig, 11 Tab, 11 Ref. OWRT A-054-UTAH(1), 14-34-0001-2147.

Descriptors: *Water supply, *Stochastic hydrology, Spectral density, *Autocorrelation, *Correlation structure, Frequency domain, Simulation, *Time series analysis, *Error analysis, Fortran language, Computer programs, Monte Carlo method.

Computer simulation of hydrologic sequences is an effective tool for estimating water yield. Present method of generating sequences have practical limits in their ability to preserve an observed autocorrelation structure. Bcause of the correspondence between the spectral density function and the autocorrelation function of a time series, the spectrum can be used to fit empirical autocorrelation structures observed in hydrologic sequences. The problem of maintaining observed correlation structure is reduced to the much easier problem of maintaining observed spectral characteristics. The series are generated in the frequency domain. The fast Fourier transform is then used to transform into the sequential domain of the process. When generating sequences from the spectrum, aliasing distorts the correlation function of the series. Direction in the choice of design parameters to eliminate the problem is given. A FORTRAN language program is provided to generate a sequence with a given spectral density function. Bias in the estimate of autocorrelation complicates the generation of sequences. If the observed autocorrelation has been estimated with bias, the associated Monte Carlo model can lead to erroneous conclusions. A method of unbiased estimation is developed and tested.
W83-02068

2B. Precipitation

AN ANALYTICAL STUDY OF SEVERE FLOODS OF JULY 1978 IN BAGMATI AND ADHWARA GROUPS OF RIVERS,
Flood Meteorological Office, Patna (India).
For primary bibliographic entry see Field 2E.
W83-01828

FLOOD METEOROLOGY OF GANGA BASIN IN BIHAR: A SYNOPTIC ANALOGUE STUDY,
Flood Meteorological Office, Patna (India).
K. Prasad, and A. K. Sen Sarma.
Mausam, Vol 32, No 4, p 415-424, October, 1981. 9 Fig, 2 Tab, 2 Ref.

Descriptors: *Floods, *Forecasting, *Meteorological data collections, Flood control, Ganga basin, Bihar, Rainfall, Storms, *India.

A detailed survey was made from available records of all past synoptic situations which resulted in heavy rainfall in different subcatchments of the Ganga basin in Bihar in different months of the monsoon season. Most of these spells are associated with either a low pressure system or a break monsoon condition. While the heavy rain associated with the break condition is confined to the immediate vicinity of the monsoon trough, effects of a low pressure system extend far beyond its location. It has been possible to delineate an area for each month and each individual subcatchment, location of a low pressure system within which is fraught with a risk of heavy rainfall in that particular subcatchment. This area has been termed as the risk zone for the subcatchment. (Baker-FRC)
W83-01829

PHYSICAL CONSIDERATIONS IN THE ANALYSIS AND SYNTHESIS OF HYDROLOGIC SEQUENCES,
Washington Univ., Seattle. Dept. of Civil Engineering.
K. M. Leytham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167593, Price codes: A12 in paper copy, A01 in microfiche. Technical Report No 76, University of Washington, Seattle, June 1982. 237 p, 65 Fig, 29 Tab, 88 Ref. OWRT A-107-WA(1) and A-115-WA(1), 14-34-0001-1151.

Descriptors: *Drought, Hydrology, *Univariate mixture models, *Precipitation, *Atmospheric nonlinearities, *Model studies, *British Columbia, Precipitation data, Classification, Rainfall distribution.

An investigation of univariate mixture models was undertaken including a study of the small sample properties of maximum likelihood parameter estimates for a mixture of two normal distributions. This study showed that while the parameters estimated from small unclassified samples are unreliable, the estimated quantiles compare favorably with those estimated using classified data. Thus the ability to classify data from a mixture distribution is not necessarily important for hydrologic applications. Analysis of long rainfall records from southern British Columbia showed that while mixture distributions fitted the data well, they are too complex to be justified for single-site precipitation modeling. The use of multi-variate mixture distributions for multi-site precipitation modeling was

explored. Such models are capable of preserving the marginal distributions and cross correlation structure of data which could not be modeled adequately using conventional models. Multi-variate mixture models also allow explicit recognition of the widespread nature of drought.
W83-01956

SOME RAINFALL FEATURES OF JULY 1979 STORM OVER LUNI BASIN,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, and N. S. Vangani.
Annals of Arid Zone, Vol 21, No 1, p 29-39, March, 1982. 7 Fig, 2 Tab, 5 Ref.

Descriptors: *Rainfall, *Storms, *Maps, Isohyetal maps, Isohyets, Precipitation, Storm events, Arid zone, Luni Basin, *India.

The rainfall features of the July 1979 storm over Luni Basin are reported. From the isohyetal maps drawn for these days it is noted that there had been three maxima of rainfall in the isohyetal pattern of 15 July. Rainfalls on the order of 10-100 mm were widespread in the Upper Luni Basin, with practically no rain in central and lower Luni basins. On 16 July the rainfall was spread over the entire Luni basin; the heaviest rain, exceeding 300 mm, occurred over Rundia and Padasla Kalan in Upper Luni catchment. The storm was more severe on 17 July, when the entire Luni Basin received rainfall exceeding 50 mm. On 18 July the storm shifted south-westward, and a maximum of 250 mm rain was recorded over Jadan, Padasla Kalan and Rundia in Guhiya and Bandi B catchments. Although the storm had weakened in the lower Luni Basin, the upper and central Luni basins had recorded rainfall on the order of 100-200 mm. By 19 July the storm had almost withdrawn from the Luni basin, except that the Upper Luni still received rain in localized spots. Depth-area-duration analysis of this storm was carried out for durations of 1, 2, 3, 4, and 5 days for each sub-catchment of Luni basin area. All of the studies indicated that the rainstorm of 15-19 July 1979 was one of the most severe and the water volume generated was much larger than that obtained in any rainstorm over this region in the past. (Baker-FRC)
W83-02002

2C. Snow, Ice, and Frost

SHALLOW FOUNDATIONS IN COLD REGIONS: DESIGN,
Hardy Associates Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 8D.
W83-01931

CONTRIBUTION OF SNOWMELT TO THE OCTOBER 1978 FLOOD OF THE POMAHAKA AND FRASER RIVERS, OTAGO,
Otago Univ., Dunedin (New Zealand).
B. B. Fitzharris, D. Stewart, and W. Harrison.
Journal of Hydrology (New Zealand), Vol 19, No 2, p 84-93, 1980. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Snowmelt, *Floods, *Estimating, Snow cover, Snowpack, Snowline, Floodwater, *New Zealand, Catchments, Rivers, Fraser River, Pomahaka River.

In three days the rapid melt of a Central Otago mountain snowpack produced 97 mm of water, which was added to the 150 mm of rainfall produced by the same storm. The energy sources for the melt were dominated by convective fluxes. The contribution of snowmelt to the major October flood of 1978 was over one-third of the flow of the Fraser River, but less than 10% of the flow of the Pomahaka River. An estimated 58% of the energy for melt may have come from turbulent transfer of sensible and latent heat to the snowpack surface. Mild, moist northwest airflows often occur in spring storms, suggesting that similar, rapid melting of the spring snowpack may be common on Otago mountains. Estimates of the heat balance suggest that there is substantial energy available from turbulent transfer of heat and water vapor to the snow surface during these warm, windy conditions. Therefore other floods, including the one in 1978, may have had an important snowmelt component from the high elevation catchments. In lower catchments the contribution of snowmelt to flooding is not important, as the area above the snowline is too small. (Baker-FRC)
W83-01988

A METHOD FOR PREDICTING WINTER OXYGEN PROFILES IN ICE-COVERED ONTARIO LAKES,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
For primary bibliographic entry see Field 2H.
W83-02099

2D. Evaporation and Transpiration

POTENTIAL OF DRIP IRRIGATION IN ROW CROPS FOR AGRICULTURE WATER CONSERVATION IN CALIFORNIA,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W83-01954

WATERBORNE NUTRIENT FLOW THROUGHAN UPLAND-PEATLAND WATERSHED IN MINNESOTA,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
E. S. Verry, and D. R. Timmons.
Ecology, Vol 63, No 5, p 1456-1467, 1982. 4 Fig, 9 Tab, 34 Ref.

Descriptors: *Nutrients, *Watersheds, Phosphorus, Calcium, Potassium, Magnesium, Sodium, *Minnesota, Evapotranspiration, Hydrology, Marcell Experimental Forest, Forest watersheds.

Water and nutrient flow were measured on a complex upland peatland watershed in north central Minnesota. Annual water budgets for upland and peatland components and for the total watershed were developed. Nutrient input and output budgets were developed for each component on a seasonal basis, using net precipitation inputs, and an annual nutrient budget was developed for the entire watershed, using gross precipitation and total outputs. Both components evapotranspire water near potential rates. The upland converts 34% of the water input to water yield, while the peatland converts 55% of its water input to water yield. The upland annually retains some N, P, K, and Ca from net precipitation, but passes through Mg and supplies Na in excess of inputs. The peatland is a nutrient trap retaining 36-60% of all nutrient inputs annually. There are striking differences in the seasonal retention of nutrient forms between the upland and bog. The total watershed accumulates P and N but loses more K, Ca, Mg, and Na than it receives in gross precipitation. Nutrient flow is interpreted for the design of nutrient-added technologies and as a bench mark for nutrient-depleted technology. (Baker-FRC)
W83-02089

2E. Streamflow and Runoff

PLOTTING POSITIONS OF ANNUAL FLOOD EXTREMES CONSIDERING EXTRAORDINARY VALUES,
Chengdu Univ. of Science and Technology (China). Dept. of Hydraulic Engineering.
Y. Zhang.
Water Resources Research, Vol 18, No 4, p 859-864, August 1982, 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Flood recurrence interval, *Frequency analysis, *Annual floods, *Mississippi River, Flood frequency, *Plotting positions, Statistical analysis, *Iowa, Keokuk, Weibull formula, Probability distribution, Historic floods.

A generalized plotting position formula was derived for estimating the flood recurrence interval or its recipropcal, the exceedance probability, for a data sample containing extraordinarily large and small values. The derivation was based on order statistics analysis and was independent of the probability distribution of the hydrologic variable. The Weibull formula was found to be a special case of the general formula. An example, using flood data on the Mississippi River at Keokuk, Iowa, dating back to 1851, illustrated the use of the formula. A 24-year (1878-1901) record plus two extremely large floods (360,000 cu ft per sec in 1851 and 344,000 cu ft per sec in 1973) and a small flood (52,500 cu ft per sec in 1930) were used to create plotting positions. (Cassar-FRC)
W83-01758

RUNS CHARACTERISTICS OF STREAMFLOWS,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and H. K. M. Vithana.
Water S A, Vol 8, No 3, p 130-137, July, 1982. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Streamflow, *Runs characteristics, *Hydrologic data, *Model studies, Drought, Mathematical studies, Statistics, *Runs theory, Data collections, *Monthly streamflows.

The theory of runs was used to analyze hydrological data (35-102 year streamflow records from 8 stations in 5 countries) with regard to wet and drought indicators. The effect of skewness and dependence of annual flows on the runs characteristics (wet and drought periods, positive and negative run sums) was studied. A model for generating monthly streamflows was developed. It reproduced the runs characteristics of observed monthly streamflows. (Cassar-FRC)
W83-01804

AN ANALYTICAL STUDY OF SEVERE FLOODS OF JULY 1978 IN BAGMATI AND ADHWARA GROUPS OF RIVERS,
Flood Meteorological Office, Patna (India).
A. K. Chaudhury, P. Prasad, and K. Prasad.
Mausam, Vol 32, No 4, p 405-410, October, 1981. 9 Fig, 2 Tab, 2 Ref.

Descriptors: *Floods, *Rainfall, *Frequency analysis, Bihar, Rivers, Topography, *Storms, *India, Adhwara, Bagnati.

Synoptic and hydrometeorological aspects of severe floods that affected the Bagmati and Adhwara groups of rivers in north Bihar in July 1978 have been studied. The findings revealed that with much lower rainfall amounts, less favorable antecedent conditions and lower initial gauge levels, the flood peaks in the downstream reaches of the rivers were higher in 1978 than in 1975. Bagmati nearly reached the 1975 highest flood level (HFL) at the upstream site, Dheng, with only one-day rainfall in 1978, compared to four-day rainfall in 1975. The high intensity of short duration rainfall in the 1978 flood spell contributed significantly to the rivers' registering higher gauge rises and overtopping the 1975 HFL at the downstream sites in spite of the total storm rainfall yield and other factors being less favorable. The study emphasized the importance of short duration rainfall intensity in formulation of flood forecasts for smaller catchments. The superimposition of a minor wave disturbance in the lower tropospheric wind flow on prevailing break conditions seems to favor enhancement of rainfall activity in the wave disturbance. (Baker-FRC)
W83-01828

FLOOD FREQUENCY ANALYSIS FOR REGULATED RIVERS,
S. G. Buchberger.
Transportation Research Record, Vol 832, p 12-21, 1981. 9 Fig, 7 Tab, 15 Ref.

Descriptors: *Case studies, *River flow, *Watershed management, *Flood peak, *Flood frequency, *Statistical methods, *Time series analysis, Mathematical studies, Stochastic process, Reservoir operation, Water sheds, Regulated flow, *Colorado, Colorado River.

A case study of the Colorado River at Glenwood Springs, Colorado, is examined to show several

statistical tests identifying watersheds having changing conditions with time. Results show that annual peak flows of the Colorado River are influenced significantly by reservoir regulation, making conventional methods of frequency analysis inadequate for obtaining flood estimates. When conventional methods are not suitable, time-series analysis is a versatile approach to flood frequency determinations. In time-series analysis each value of the regulated annual peak-flow series is treated as a combination of two elements - a deterministic component and a stochastic component. The deterministic factor is quantified and removed from the flood series, while the stochastic components which are stationary and independent are fitted to a probability distribution from which annual floods are estimated. Time-series analysis gives 2% and 1% chance flood values (required for Interstate Highway design) that are substantially less than corresponding log-Pearson type III estimates. The resulting flood frequency estimates are more representative of the watershed due to the ability of time-series analysis to detect and treat the impact of reservoir regulation on the peak-flow series. (Geiger-FRC)
W83-01833

ESTIMATING THE MAGNITUDE OF PEAK DISCHARGES FOR SELECTED FLOOD FREQUENCIES ON SMALL STREAMS IN SOUTH CAROLINA (1975),
Geological Survey, Columbia, SC. Water Resources Div.
B. H. Whetstone.
Available from OFSS, USGS Box 25425, Fed Ctr, Denver, CO 80225. Paper copy $2.00, Microfiche $3.50. Geological Survey Open-File Report 82-337, 1982. 13 p, 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Estimating, *Flood peak, *Flood frequency, *Small watersheds, Streams, Flood recurrence interval, Gaging stations, Flood data, Regression analysis, South Carolina.

A program to collect and analyze flood data from small streams in South Carolina was conducted from 1967-75, as a cooperative research project with the South Carolina Department of Highways and Public Transportation and the Federal Highway Administration. As a result of that program, a technique is presented for estimating the magnitude and frequency of floods on small streams in South Carolina with drainage areas ranging in size from 1 to 500 square miles. Peak-discharge data from 74 stream-gaging stations (25 small streams were synthesized, whereas 49 stations had long-term records) were used in multiple regression procedures to obtain equations for estimating magnitude of floods having recurrence intervals of 10, 25, 50, and 100 years on small natural streams. The significant independent variable was drainage area. Equations were developed for the three physiographic provinces of South Carolina (Coastal Plain, Piedmont, and Blue Ridge) and can be used for estimating floods on small streams. (USGS)
W83-01853

AT-A-STATION HYDRAULIC GEOMETRY OF THE PLATTE RIVER IN SOUTH-CENTRAL NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W83-01856

COST EFFECTIVE STREAM-GAGING STRATEGIES FOR MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7A.
W83-01857

FLOODS OF MAY 1981 IN WEST-CENTRAL MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, R. J. Omang, J. A. Hull, and J. W. Fassler.
Geological Survey Water-Resources Investigations 82-33, June 1982. 20 p, 9 Fig, 2 Tab, 4 Ref.

Descriptors: *Floods, *Flood peak, *Flood discharge, *Flood frequency, Rainstorms, Flood damage, Streamflow, Sediments, Data collections, Flood hydrographs, *Montana, Clark Fork basin, Missouri River basin.

Extensive flooding occurred in west-central Montana during May 22-23, 1981, as a result of a series of rainstorms. Flooding was particularly severe in the communities of East Helena, Belt, and Deer Lodge. Although no lives were lost, total flood damages were estimated by the Montana Disaster Emergency Services Division to be in excess of $30 million. Peak discharges were determined at 75 sites in the flooded area. At 25 sites the May 1981 peak discharge exceeded the computed 100-year frequency flood, and at 29 sites, where previous flow records are available, the May 1981 peak discharge exceeded the previous peak of record. (USGS)
W83-01861

ENVELOPE CURVES FOR EXTREME FLOOD EVENTS,
Geological Survey, Menlo Park, CA.
J. R. Crippen.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1208-1212, October, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Flood forecasting, *Drainage area, Historic floods, Graphical analysis, Basins.

Maximum flood experience in a region can be depicted by a graph on which maximum known floods are plotted against drainage area. Envelope curves, described by equations, are developed for 17 regions in the U.S. Since most of the data is from large or medium basins, an envelope curve for maximum floods nationwide is not appropriate without including factors in addition to basin area. The curves do not indicate flood probability or frequency. However, a large flood in one location in the region may be approached or equaled at other basins in the same region. The curves cannot be used for specific engineering applications, only for rule-of-thumb estimates of potential flood risk. (Cassar-FRC)
W83-01919

SIMPLIFIED TESTING OF HYDROLOGIC REGRESSION REGIONS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W83-01922

BED MATERIAL SORTING IN POOLS AND RIFFLES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W83-01925

NUMERICALLY COMPUTED MULTIPLE STEADY STATES OF VERTICAL BUOYANCY-INDUCED FLOWS IN COLD PURE WATER,
State Univ. of New York at Buffalo, Amherst. Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W83-01989

ON THE STRUCTURE OF TURBULENT CHANNEL FLOW,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Mechanics.
For primary bibliographic entry see Field 8B.
W83-01990

BOUYANCY-DRIVEN CIRCULATION IN FREE-SURFACE CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8B.
W83-01991

DYNAMIC WATER ROUTING UTILIZING A PREDICTOR-CORRECTOR METHOD WITH SEDIMENT ROUTING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. B. Simons, R. M. Li, J. Garrecht, and R. K. Simons.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-168021, Price codes: A07 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 117, Fort Collins, September 1982. 145 p, 12 Fig, 5 Tab, 30 Ref, 4 Append. OWRT B-228-COLO(1), 14-34-0001-1212.

Descriptors: *Flood Routing, *Flood Waves, *Unsteady Flow, Dynamic Water Routing, Sediment Routing, Salt River, *Arizona, *St. Venant aquations, Model studies, Prediction-corrector method.

A stable and efficient dynamic water routing method is presented which overcomes the difficulties of many numerical models by introducing physical concepts into the finite difference solution technique. Stability restrictions or complexity of the explicit and implicit schemes are overcome without reverting to simplifications of the complete St. Venant equations, but by controlling the flood wave movement in space and time with the nonlinear wave celerity. Simplicity and efficiency in the solution technique is attained by solving the governing equations in an uncoupled manner with a predictor-corrector method. The use of a predictor-corrector method inhibits the growth of error by reconsidering and readjusting the predicted values in the corrector step. The model was successfully applied to a general case which included computation of bed elevation changes based on sediment routing by sizing fraction. The completeness and efficiency of the dynamic water routing model DYNWAR makes it particularly interesting for general studies of large river systems with mild and steep channel improvements where the backwater and dynamic effects are relevant and also for sediment routing to evaluate bed elevation changes.
W83-02072

2F. Groundwater

GROUND WATER QUALITY IN SOUTHEASTERN MINNESOTA,
Minnesota Univ., Minneapolis. School of Public Health.
For primary bibliographic entry see Field 5B.
W83-01791

RECOVERY IN LARGE DIAMETER WELLS,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
For primary bibliographic entry see Field 8B.
W83-01924

ASSESSMENT OF FRACTURE-TRACE MAPPING AS A GROUNDWATER PROSPECTING TOOL IN THE METAMORPHIC TERRANE SURROUNDING FAIRBANKS, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 4B.
W83-02060

PREDICTING THE SPECIFIC CAPACITIES OF WELLS PENETRATING THE OCALA AQUIFER BENEATH THE DOUGHERTY PLAIN, SOUTHWEST GEORGIA,
Georgia Univ., Athens. Dept. of Geography.
G. A. Brook, and C-H. Sun.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167965, Price codes: A05 in paper copy, A01 in microfiche. Georgia Institute of Technology, Atlanta, Environmental Resources Center, Report Number ERC 09-82, September 1982, 86 p, 19 Fig, 24 Tab, 22 Ref. OWRT A-086-GA(1), 14-34-0001-0111.

Descriptors: *Fractures, *Fractures traces, *Groundwater, *Hydrogeology, *Karst, Lineaments, Sink holes, *Sinks, *Specific capacity,

*Wells, Well productivity, *Georgia, Dougherty Plain, Ocala Aquifer.

Within the Dougherty Plain region of Georgia, well specific capacities in gpm/ft are significantly higher when wells are located within a zone extending for 97 feet on either side of a fracture trace. The mean specific capacity of 18 fracture trace wells (i.e. within 97 feet of a fracture trace) examined was 435 gpm/ft; the mean of 21 nonfracture trace wells was 85 gpm/ft. The model recommended for use in predicting fracture trace well specific capacity is: Log sub e (SPECA) = 5.75-0.0129 (DISTL) + 0.0144 (INTNO) + 0.00015 (CLOLEN), where SPECA is specific capacity in gpm/ft, DISTL is the distance in feet from the well to the nearest fracture trace, INTNO is the number of fracture trace intersections per mi super 2 in the area around the well, and CLOLEN is the length in feet of the fracture trace on which the well is located. This model explains 77% of the variation in fracture trace well specific capacity. The model recommended for use in predicting nonfracture trace well specific capacity is: Log sub e (SPECA) = 5.75.0.0033 (DISTL 2), where DISTL 2 is equal to DISTL or DISIK (the distance in feet from the well to the center of the closest fracture trace) whichever is smaller. This model explains 82% of the variance in nonfracture trace well specific capacity.
W83-02066

2G. Water In Soils

WATER CONDUCTION IN HAWAII OXIC SOILS,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. E. Green, L. R. Ahuja, S-K. Chong, and L. S. Lau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154401, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 143, August 1982. 132 p, 33 Fig, 30 Tab, 48 Ref, 4 Append. OWRT B-048-HI(1), B-054-HI(6), 14-34-0001-7026, -7116, 14-34-0001-7116, -8075.

Descriptors: *Soil water movement, *Soil water storage, *Hydraulic conductivity, *Unsaturated soils, Drainage, Infiltration, *Hawaii, *Oaha, Soil surveys, *Oxisols, Green-Ampt model, Wahiawa plateau, Waikele watershed.

Oxic soils on Oaha were studied to develop and test simplified methods of determining the hydraulic conductivity of unsaturated soils, to test some simple infiltration models, and to assess the utility of soil survey mapped units in defining hydrologically similar soils. Field measurements of water infiltration and redistribution were accomplished on 21 sites located on the Lahaina, Molokai, and Wahiawa soil series. Water retention curves measured on undisturbed soil cores from the Ap1, Ap2, and B horizons of each site provided a means of determining the downward flux of water during redistribution from soil water suction measurements over time. These data allowed calculation of hydraulic conductivities (by a detailed Darcy analysis) of soil at various depths in the soil profile and for a range of water contents and suctions. The detailed analysis and field infiltration data provided a means of evaluating two new simplified methods of determining hydraulic conductivity functions of well-drained soils; the new methods are sufficiently accurate and economical to be used in watershed characterization. Also, field measured sorptivity and water redistribution data were used to successfully predict cumulative infiltration with the Talsma-Parlange and Green-Ampt equations, respectively. Statistical analysis of field and laboratory data suggested that soil maps of central Oaha would not be particularly useful in delineating soil areas of ralative homogeneity with respect to hydrologic properties. These results further empahsize the need for simple methods to characterize hydrologic properties of importance.
W83-01794

WASTEWATER TREATMENT IN SOIL AS A FUNCTION OF RESIDENCE TIME IN THE ROOT ZONE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W83-01950

NITRIFICATION, DENITRIFICATION, AND SORPTION-DESORPTION OF NH SUB 4-N IN SANDS DURING WATER MOVEMENT TO SUBSURFACE DRAINS,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W83-01955

THE DESIGN AND APPLICATION OF VERTICAL DRAINS,
For primary bibliographic entry see Field 8D.
W83-02094

2H. Lakes

METALIMNETIC OXYGEN DEPLETION IN LAKE MEAD AS IT RELATES TO THE LIMNETIC ZOOPLANKTON COMMUNITY,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W83-01789

DISTRIBUTION OF OLIGOCARBOPHILIC AND SAPROPHYTIC BACTERIA IN LAKE PLUSSSEE (VERTEILUNG DER OLIGOCARBOPHILEN UND SAPROPHYTISCHEN BAKTERIEN IM PLUSSSEE),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Moaledj, and J. Overbeck.
Archiv fur Hydrobiologie, Vol 93, No 3, p 287-302, February, 1982. 8 Fig, 41 Ref. English Summary.

Descriptors: *Limnology, *Bacteria, *Annual distribution, *Saprophytic bacteria, *Oligocarbophilic bacteria, Bacterial analysis, Water analysis, *Eutrophic lakes, *Federal Republic of Germany, Lake Plusssee, Culture media, Seasonal variation.

The annual distribution of oligocarbophilic and saprophytic bacteria was studied in the eutrophic Plusssee (Federal Republic of Germany) by cultivating bacteria taken from various lake depths (1, 5, 10, and 20 m) on various media. The number of oligocarbophilic bacteria, grown on mineral or diluted media, was higher than that of the saprophytic bacteria, grown on undiluted nutrient agar – approximately twice as high in most cases. Through the use of media with different nutrient components, different groups from the total bacterial population could be studied in relation to the nutrient composition of the ecosystem. The CPS medium made available a large number of organic carbon sources and inorganic components, favoring the growth of the largest number of taxonomic groups of bacteria. The seasonal vertical distribution of oligocarbophilic bacteria and heterotrophic saprophytes was, with few exceptions, essentially the same at all depths tested. Both groups displayed a short, slight late-autumn (November/December) maximum, followed by a winter minimum until mid-April, when the summer maximum (which peaked in June) set in; after this, a minimum was in effect until November. The number of both groups of bacteria decreased with depth, presumably due to oxygen decrease and unfavorable temperature. When bacteria were cultivated on agar in an atmosphere free from organic carbon, fewer colonies were counted than in normal air. (Gish-FRC)
W83-01823

THE PHOSPHORUS CYCLE IN GERMISTON LAKE. III. SEASONAL PATTERNS IN THE ABSORPTION, TRANSLOCATION AND RELEASE OF PHOSPHORUS BY POTAMOGETON PECTINATUS L.,
Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater Biology.
J. F. Vermaak, J. H. Swanepoel, and H. J. Schoonbee.
Water SA, Vol 8, No 3, p 138-141, July, 1982. 3 Tab, 29 Ref.

Descriptors: *Phosphorus, *Seasonal variation, *Macrophytes, Absorption, *Potamogeton pectinatus, Germiston Lake, Nutrients, Aquatic plants, Rooted aquatic plants, Cycling nutrients, *South Africa.

Potamogeton pectinatus L. in the littoral zone of Germiston Lake acts as a phosphorus reservoir. Solutions containing P-32 as phosphate were applied either to the root compartment or to the shoot compartment to Potamogeton in experimental containers during each of the 4 seasons. Plants were kept under conditions simulating daylight incubation or night incubation. Shoot absorption was greater than root absorption in spring and winter; the reverse was true in summer and autumn. Shoots released more P per plant than roots. Both shoots and roots absorbed much more P than they released. Since plants do not discriminate between P-31 and P-32, activity was converted to P-31. The absorption of P-31 (in micrograms) per 24 hours by the plants (after adapting the light-dark periods to the standard day and night lengths of the respective seasons) were: spring, root 94 and shoot 1849; summer, root 1162 and shoot 578; autumn, root 13966 and shoot 1992; and sinter, root 91 and shoot 562. Releases of P-31 (in micrograms) were: spring, root 5 and shoot 21: summer, root 5 and shoot 15; autumn, root 5 and shoot 47: and winter, root 22 and shoot 110. (Cassar-FRC)
W83-01824

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XIII, REPRODUCTIVE CHARACTERISTICS OF GREAT LAKES FISHES,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01883

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XIV, LITERATURE CITED,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 10F.
W83-01884

PREDICTING PHOSPHORUS LEVELS IN A FUTURE RESERVOIR,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. W. Effler, S. D. Field, J. V. DePinto, E. M. Owens, Jr, and J. S. Dobi.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 688-705, August, 1982. 8 Fig, 2 Tab, 44 Ref.

Descriptors: *Phosphorus, *Reservoir operation, *Flow augmentation, Reservoir releases, Delaware River, Eutrophic lakes, Mesotrophic lakes, Model studies, New Jersey, Trenton.

The concentrations of total phosphorus at spring turnover were predicted for a proposed flow-augmentation reservoir on the Delaware River. Hypothetical data sets for 1929-1970 were used in two dynamic models (Dillon-Rigler and Lorenzen) and a steady state model for a wide range of reservoir operations. The reservoir will have a 60 million cu m capacity, an area of 2.5 million sq m, and a mean depth of 23.1 m. Releases are planned when flows at Trenton, New Jersey, are in the 85-89 cu m per sec range. Total P will be highly dependent on hydraulic operation of the reservoir. Dynamic models proved more suitable than the steady state model for simulating the substantial annual variation in total P at spring turnover. Differences between the two types of models were especially large immediately following a sudden change in operation. Both dynamic models give similar predictions; response time of 4 years and a transition

phase of 6 years. However, the Lorenzen model is more appropriate for a system which receives infrequent high loadings, since it is sensitive to recent P concentrations in sediment and water column. The reservoir should be continuously eutrophic (over 0.02 mg per liter P), bordering on mesotrophy during years when no releases are made. (Cassar-FRC)
W83-01905

PERFORMANCE OF SOME EMPIRICAL PHOSPHORUS MODELS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. S. Mahamah, and S. K. Bhagat.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 4, p 722-729, August, 1982. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Phosphorus, *Trophic level, *Lake classification, Lakes, Nutrients, Jones-Bachman phosphorus model, Dillon-Kirchner phosphorus model, Kirchner-Dillon phosphorus model, Walker model, Model studies.

Four empirical phosphorus models were compared using data from 22 western lakes (oligotrophic, oligomesotrophic, and mesotrophic). The Jones-Bachman model and the Walker model results agreed well with observed P concentrations. The Dillon-Kirchner and Kirchner-Dillon models showed poor correlation with observed data. All models tended to underestimate P levels. Assuming that the USEPA National Eutrophication Survey trophic classification is correct, the Jones-Bachman and Walker models misclassified 23% of the lakes; the Dillon-Kirchner models misclassified 35%. (Cassar-FRC)
W83-01906

TEMPERATURE/SEDIMENT MODEL FOR A SHALLOW LAKE,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 5B.
W83-01945

COOLING PROCESSES IN DEEP, TEMPERATURE LAKES: A REVIEW WITH EXAMPLES FROM TWO LAKES IN BRITISH COLUMBIA,
National Water Research Inst., Vancouver (British Columbia).
E. C. Carmack, and D. M. Farmer.
Journal of Marine Research, Vol 40, Supplement, p 85-111, 1982. 11 Fig, 73 Ref.

Descriptors: *Mixing, *Destratification, *Lakes, *Thermal stratification, *Reviews, *Thermocline, *Density currents, *Wind-driven currents, Temperate zone, Stratification, Density stratification, Isotherms, Density, Water temperature, *British Columbia.

In deep temperature lakes, the cooling period includes the breakdown of the seasonal thermocline, isothermal overturn as the lake cools through 4 degrees, and winter re-stratification. A review of the few studies that have been performed on the cooling of lakes shows that more information is needed on the mixing processes whereby heat is transferred from the interior of a lake to the surface, where it is lost to the atmosphere. With this fact in mind, a comparison was made of the thermal history and mixing properties of two deep lakes in central British Columbia. Some characteristics of the evolution of thermal structure can be explained by mixed-layer theory. However, at temperatures near 4 degrees, the density, volume and temperature properties of freshwater should be considered. Two- and three-dimensional processes may also influence circulation at various times and/or locations. These processes may include increased mixing associated with large-amplitude internal seiches, retardation of mixed-layer advance by river-induced upwelling, and thermal bar circulation driven by the differential cooling of water in shallow tributary bays. Circulation may also be affected by horizontal density flows resulting from differential wind mixing in sheltered arms of the lake prior to freezing. (Geiger-FRC)
W83-01987

PLANKTONIC CILIATES: THEIR DISTRIBUTION, ABUNDANCE, AND RELATIONSHIP TO MICROBIAL RESOURCES IN A MONOMICTIC LAKE,
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. L. Pace.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 8, p 1106-1116, August, 1982. 4 Fig, 6 Tab, 42 Ref.

Descriptors: *Biomass, *Protozoa, *Lakes, *Population density, Aquatic populations, Bacteria, Hydrobiology, Plankton, Chlorophyll a, Stratification, Density stratification, Mixing, Pigments, *Georgia, Lake Oglethorpe, Monomictic lakes.

The abundance, biomass, vertical distribution, and seasonal succession of planktonic ciliates were studied over a 13 month period in Lake Oglethorpe, a small monomictic lake near Athens, Georgia. Measurements taken concurrently of bacterial abundance, chlorophyll a, and pheopigments were analyzed for correlations with the biomass of major protozoan species and total protozoan biomass. Ciliate community structure varied mostly between winter mixis and summer stratification. Vertical distribution tended to be uniform except for species with algal symbionts. During stratification, a more diverse community occurred. With the development of anoxia in the hympolimnion, bacteriovirus scuticociliates dominated the community in terms of density and to a lesser extent, biomass. Highest protozoan densities occurred from August through October, while peak biomass occurred in November with blooms of Rhabdostyla. Total ciliate biomass was correlated with pheopigment concentration, but when Rhabdostyla biomass was subtracted, significant correlations were observed between protozoan biomass and chlorophyll a, pheopigments, and bacterial abundance. It was concluded that concentrations of appropriate food resources are important in determining the abundance of heterotrophic ciliates in lake plankton. (Geiger-FRC)
W83-02078

LIGNIN GEOCHEMISTRY OF A LATE QUATERNARY SEDIMENT CORE FROM LAKE WASHINGTON,
Washington Univ., Seattle. School of Oceanography.
J. I. Hedges, J. R. Ertel, and E. B. Leopold.
Geochimica et Cosmochimica Acta, Vol 46, No 10, p 1869-1877, 1982. 5 Fig, 3 Tab, 38 Ref.

Descriptors: *Sediments, *Geochemistry, *Organic carbon, *Lake sediments, Lakes, Lake Washington, *Washington, Phenols, Lignin, Cupric oxide, Oxidation, Sediment cores.

Long term lignin stability and paleovegetation patterns were studied using CuO oxidation products of sediments from an 11 m core of Late Quaternary sediment collected from the mid-basin of Lake Washington, Washington State. Relatively constant yields of lingin-derived phenols from the entire core indicate minimal in situ lignin degradation over the last 13,000 years. Compositional patterns within the phenolic suite and increased corresponding yields from base extracted sediments indicate that sedimentary lignins are preseent predominantly as well preserved plant tissue fragments. Abundance patterns of vanillyl, syringyl, and cinnamyl phenols record four distinct sequences within the core, characterized by: high concentrations of gymnosperm wood in basal horizon of glacial flour, 11-10 m; an essentially pure mixture of nonwoody angiosperm tissues in late Pleistocene sediments, 10-8 m; relatively high concentrations of angiosperm woods in the bottom half of a limnic peat sequence deposited approximately 10,000-7,000 years B.P., 8-4 m; and a progressive enrichment in gymnosperm woods at the expense of angiosperm woods over the last 7,000 years in the upper limnic peat, 4-0 m. Vascular plant tissues account for less than half the total sedimentary organic carbon throughout the core. (Baker-FRC)
W83-02088

THE APPLICATION OF A NEW METHOD FOR THE DETERMINATION OF PARTICLE DEPOSITION ONTO A LAKE,
Trent Univ., Peterborough (Ontario).
H. H. Banks, and J. E. Nighswander.
Ecology, Vol 63, No 5, p 1254-1258, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Pollen, *Lakes, *Distribution, Deposition, Air pollution, Planimetry, Water pollution sources, *Ontario, Clear Lake, *Pollutant identification.

A new method is decribed for the determination of total particle deposition onto a lake. Tests are conducted on experimentally determined Tsuga canadensis and Pinus spp. pollen deposition values obtained from traps placed on Clear Lake, Ontario. The method is based on the distance vs. quantity relationship, and uses planimetry to integrate lake surface areas at various distances from shore. The first step in this procedure is to draw isopleths on a map of Clear Lake, connecting points that are equidistant from the shore. Results of pollen calculations made with this method were compared to those calculated with the Thiessen method and a mean method. General agreement among the methods was achieved. The major advantage of the new method is that it can be applied to any lake using only a scaled map and a planimeter, if a general relationship between distance from shore and particle distribution has been or could be established. (Baker-FRC)
W83-02090

A METHOD FOR PREDICTING WINTER OXYGEN PROFILES IN ICE-COVERED ONTARIO LAKES,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
M. B. Jackson, and D. C. Lasenby.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 9, p 1267-1272, September, 1982. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Lakes, *Ice cover, *Oxygen uptake, Respiration, Seasonal variations, Water depth, Oxygenation, Oxidation, Shield lakes, Limestone lakes, Oxygen depletion, *Ontario.

A simple method is presented for predicting oxygen profiles under ice cover in selected Ontario lakes. The oxygen loss rate within individual lake strata over winter can be predicted from the oxygen concentration in each stratum about 5-15 days after freeze-up (at the time of maximum volume-weighted oxygen concentration for the lake). Shield lakes and limestone transition lakes are described by two distinct relationships; the rate of oxygen loss per unit oxygen concentration is greater in the limestone-transition lakes. The lower rates in shield lakes might indicate that these lakes are characterized by oxidizable material that is relatively lesser in quantity and more refractory in quality. To improve the usefulness of the method as presented here, it is recommended that a study be made of factors affecting winter oxygen loss in a variety of lake types. (Baker-FRC)
W83-02099

2I. Water In Plants

THE VASCULAR PLANTS OF THE HACKENSACK RIVER AREA,
Rutgers - The State Univ., New Brunswick, NJ.
M. Foote.
Phytologia, Vol 50, No 1, p 15-45, December 1981. 13 Ref. A-063-NJ(2), 14-34-0001-1132.

Descriptors: *Vegetation survey, *New Jersey, *Taxonomy, Systematics, *Hackensack River Estuary, Hackensack meadowlands, *Vascular plants, Floral list.

The upper Hackensack River-Estuary is located in Bergen County New Jersey. It includes industrial,

residential and commercial areas. An annotated list of vascular plants was produced from collections made by the author from June, 1980 to October, 1981, herbarium records and literature sources. Three hundred-sixty-two (362) taxa are found along the Hackensack River from the Hackensack Meadowlands to the Oradell Reservoir Dam.
W83-01797

SALINITY-PRODUCTIVITY RELATIONSHIPS OF SELECTED PLANT SPECIES FROM THE SUISUN MARSH, CALIFORNIA,
California Univ., Davis. Dept. of Botany.
R. W. Pearcy, and D. E. Bayer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154450, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, California Water Resources Center, University of California, Davis, November, 1982, 42 p, 15 Fig. OWRT B-189-CAL(1).

Descriptors: *Salinity, *Saline-freshwater interfaces, *Halophytes, *Salt tolerance, Salt marshes, Productivity, Aquatic productivity, *Bulrushes, *California, Suisan Marsh, Spartina, Scirpus, Plant growth, Photosynthesis.

The influence of salinity on the productivity of four plant species occurring or potentially occurring in Suisun Marsh was investigated with laboratory measurement of growth, photosynthetic responses and competitive interactions, and field measurements of water relations, growth and carbohydrate reserves. Special emphasis was placed on the responses of Scirpus robustus and its competitors because of its importance as a waterfowl food source. The results showed that photosynthesis and growth were much more reduced by increased salinity in Scirpus than in Spartina foliosa, Salicornia virginica orcotula cornupifolia. However, at low salinities Scirpus had the highest growth rates. Competition studies showed a strong shift in competitive advantage from Scirpus at low salinities to Salicornia at high salinities. Field studies showed that at most sites where Scirpus occurs, there is a strong seasonal change in salinity from nearly fresh water in the spring to high summer salinity levels. The rapid growth of Scirpus at the low salinity present during the spring may give it a competitive advantage over Salicornia. Scirpus also exhibited considerable tolerance to high salinities--defined here as an ability to survive even though growth was completely stopped. This tolerance may be important since high summer salinities could prevent encroachment of less salt tolerant but highly competitive and less desirable species such as Scirpus acutus or Typha latifolia. We conclude that management plans designed to enhance Scirpus productivity should put as much weight on maintaining an annual cycle of salinity as reducing the yearly average salinity. (Snyder-California)
W83-01802

WETLAND HYDROLOGY AND TREE DISTRIBUTION OF THE APALACHICOLA RIVER FLOOD PLAIN, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. M. Leitman, J. E. Sohm, and M. A. Franklin.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $13.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-251, 1982. 92 p, 39 Fig, 14 Tab, 70 Ref.

Descriptors: *Wetlands, *Trees, *Distribution patterns, *Flood plains, Soil water, Forests, Hardwood, River basins, Flood stages, Flow duration, Levees, Surface water, Water level, *Florida, Apalachicola River.

The Apalachicola River is part of a 50,800-square-kilometer drainage basin in northwest Florida, Alabama, and Georgia. The river is formed by the confluence of the Chattahoochee and Flint Rivers at Jim Woodruff Dam and flows 171 kilometers to Apalachicola Bay in the Gulf of Mexico. Its flood plain supports 450 square kilometers of bottomland hardwood and tupelco-cypress forests. The most common trees, constituting 62 percent of the total basal area, were five wet-site species; water tupelo, Ogeeche tupelo, baldcypress, Carolina ash, and swamp tupelo. Other common species were sweetgum, overcup oak, planertree, green ash, water hickory, sugarberry, and diamond-leaf oak. Five forest types were defined based on species predominance by basal area. Biomass increased downstream and was greatest in forests growing on permanently saturated soils. Water and tree relations varied with river location because range in water-level fluctuation and topographic relief in the flood plain diminished downstream. Heights of natural riverbank levees and size and distribution of breaks in levees had a major controlling effect on flood-plain hydrology. Depth of water, duration of inundation and saturation, and river location, but not water velocity, were very highly correlated with forest types. (USGS)
W83-01850

THE AQUATIC AND WETLAND VASCULAR PLANTS OF NORTH DAKOTA,
North Dakota State Univ., Fargo. Dept. of Botany.
G. E. Larson, and W. T. Barker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167973, Price codes: A20 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, North Dakota State Univ., Fargo, January 1983. 453 p, 35 Ref, 1 Append. OWRT A-064-NDAK(1), 14-34-0001-9036.

Descriptors: *Aquatic plants, *Wetland vascular plants, On-site investigations, Ecosystems, Aquatic environment, Publications, *Taxonomy, *North Dakota, *Plant populations, Plant habitats, Plant species, Classification.

A toxonomic treatment of the aquatic and wetland vascular plants of North Dakota is provided as a means of identifying the vascular plants encountered in wetland habitats of the state. The treatment includes diagnostic keys, plant descriptions and statements of range, habitat preferences and flowering/fruiting periods to accommodate the identification of wetland plant species. Infraspecific taxa and their diagnoses are described following species descriptions where appropriate. References to literature on the taxonomy and distribution of many species and species groups are cited in the body of the treatment. Short discussions of taxonomic problems follow descriptions of some problematic groups. The entities covered in the treatise includes 62 families, 152 genera and 390 species of vascular plants. These include 48 species newly recorded for North Dakota since the 1963 publication of Steven's Handbook of North Dakota Plants.
W83-02067

2J. Erosion and Sedimentation

MICROBIAL ACTIVITY AND BIOTURBATION-INDUCED OSCILLATIONS IN PORE WATER CHEMISTRY OF ESTUARINE SEDIMENTS IN SPRING,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. Hines, W. H. Orem, W. B. Lyons, and G. E. Jones.
Nature, Vol 299, No 5882, p 433-435, September, 1982. 1 Fig, 20 Ref.

Descriptors: *Interstitial water, *Chemical reactions, *Microorganisms, Sediments, Esturarine environment, Estuaries, Seasonal variation, Bottom sediments, Oscillatory waves, *New Hampshire, Great Bay estuary.

In an attempt to clarify the chain of sedimentary events occuring between the relatively oxidizing, inactive winter and the highly reducing, active summer, several chemical and biological parameters were examined in samples of estuarine sediment collected from February to July of 1980. The combined effects of increasing microbial activity and the onset of rapid bioturbation produced oscillations in the concentrations of pore water constituents in these sediments. Most importantly, metals may undergo rapid speciation changes which could influence the flux of pollutants into the water column and the distribution of sedimentary minerals. (Baker-FRC)
W83-01771

FLOOD CONTROL FAILURE: SAN LORENZO RIVER, CALIFORNIA,
California Univ., Santa Cruz. Dept. of Earth Sciences.
For primary bibliographic entry see Field 4A.
W83-01783

SEDIMENTATION AND APPARENT SEA-LEVEL RISE AS FACTORS AFFECTING LAND LOSS IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W83-01863

MUDFLAT AND MARSH PROGRADATION ALONG LOUISIANA'S CHENIER PLAIN: A NATURAL REVERSAL IN COASTAL EROSION,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 2L.
W83-01864

CANALS AND WETLAND EROSION RATES IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W83-01866

REVERSAL OF COASTAL EROSION BY RAPID SEDIMENTATION: THE ATCHAFALAYA DELTA (SOUTH-CENTRAL LOUISIANA),
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
H. H. Roberts, and I. L. van Heerden.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82-59, September 1982. p 214-231, 14 Fig, 14 Ref. DACW 29-77-C-0163.

Descriptors: *Deltas, *Sedimentation, *Marshes, *Floods, *Mississippi Rivers, *Louisiana, Erosion, Coasts, Progradation, Backwater effect, Water level, Wetlands, Atchafalaya Delta.

In the early 1950's Atchafalaya Bay began experiencing sedimentation, which marked the initiation of a new major delta lobe in the Mississippi River Delta complex. This new era will be characterized by rapid progradation and marshland growth in parts of coastal Louisiana that have been typified by coastal retreat for hundreds of years. As a product of the abnormally severe 1973 flood, the delta became a subaerial feature characterized by sand-rich lobes which are prograding at a rapid rate. During 1972-77 approximately 32.5 sq km of new marsh land was added to Atchafalaya Bay as a product of sedimentation. Similar processes are occurring at the mouth of Wax Lake outlet. Systematic monitoring of changes within the delta system over the last 4 years has shown that delta growth responds directly to flood volume and duration. Analysis of LANDSAT imagery reveals that Wax Lake suffered a net loss of subaerial expression during the period 1976-78. Land loss was reversed during the major flood of 1979. The presence of deltas at Lower Atchafalaya River and Wax Lake outlets has elevated water levels near the coast during floods (backwater effect), causing sediment-rich water to be transported into surrounding marshes. The net effect is marsh aggradation and restoration in flood areas. Rapid sedimentation has reversed the traditional trend of coastal erosion in the vicinity of Atchafalaya Bay and is now initiating a new growth phase of the downdrift chenier plain. (Moore-SRC)
W83-01869

TIME SCALE FOR SCOUR DOWNSTREAM OF HYDRAULIC JUMP,
For primary bibliographic entry see Field 8B.
W83-01889

ANALYTICAL APPROACH TO RIVER REGIME,
Hydraulics Research Station, Wallingford (England).
W. R. White, R. Bettess, and E. Paris.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1179-1193, October, 1982. 7 Fig, 28 Ref.

Descriptors: *Sediment transport, *Channel morphology, *Stable channels, Rivers, Cross sections, Alluvial channels, Equilibrium, Sand, Gravel.

A new analytical method, based on maximizing sediment transport rates, was developed to predict the hydraulic and geometric character of alluvial channels, both sand and gravel. It used the Ackers and White sediment transport formulas and the White, Paris, and Bettess frictional relationships with the principle of maximum sediment transporting capacity. Results of the method compared favorably with data obtained from the literature. Predictions of channel slopes were more scattered than observations. There was a slight tendency to overestimate slopes. Predictions of widths were generally excellent, except for very large sand channels and for meandering laboratory channels. Predictions of gravel channel widths were not as good as for sand bed rivers. (Cassar-FRC)
W83-01921

BED MATERIAL SORTING IN POOLS AND RIFFLES,
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik, and M. Demissie.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1227-1231, October, 1982. 3 Fig, 8 Ref.

Descriptors: *Sediment transport, *Low flow, *Sediment sorting, *Riffles, Bed load, Streams, Kaskaskia River, *Illinois, Froude number.

Bed material sorting in two pool-riffle sequences in the Kaskaskia River below Lake Shelbyville, Illinois, was investigated for a discharge of 58 cfs. Data included velocity measurements, water surface and bed profile data, and bed materials (50 samples). Sorting was mainly due to the high bed shear associated with the high velocity of the riffles, where fine matrials were washed away and deposited in the pools downstream. Coarser particles remained in the riffles. This sorting occurred during low discharges when differences in water velocity between riffle and pool were greatest. The water surface profile and the invert slope were steep in the riffles and milder in the pools. The Froude number changed from high in the riffle to low in the pool. Bed material changed from coarser to finer in the riffle-pool sequence. Larger particle sizes were associated with higher Froude numbers and vice versa. (Cassar-FRC)
W83-01925

DYNAMIC WATER ROUTING UTILIZING A PREDICTOR-CORRECTOR METHOD WITH SEDIMENT ROUTING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-02072

LIGNIN GEOCHEMISTRY OF A LATE QUATERNARY SEDIMENT CORE FROM LAKE WASHINGTON,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2H.
W83-02088

2K. Chemical Processes

MICROBIAL ACTIVITY AND BIOTURBATION-INDUCED OSCILLATIONS IN PORE WATER CHEMISTRY OF ESTUARINE SEDIMENTS IN SPRING,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
For primary bibliographic entry see Field 2J.
W83-01771

NUTRIENT DISTRIBUTIONS AND THEIR RELATIONSHIPS TO WATER MASSES IN BAFFIN BAY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
A. R. Coote, and E. P. Jones.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 8, p 1210-1214, August, 1982. 3 Fig, 11 Ref.

Descriptors: *Bays, *Salinity, *Nutrients, *Water temperature, *Chemical stratification, *Distribution patterns, Temperature, Nitrates, Silicates, Phosphates, Thermal stratification, *Baffin Bay.

The distributions of phosphate, nitrate, and silicates in Baffin Bay, situated between Canada and Greenland, were measured and related to water masses identified by salinity and temperature. Samples for nutrient analyses were collected during August and Septmber of 1977 at 14 different stations. Temperature measurements were also taken at selected depths. Results showed a remarkable homogeneity of the water structure throughout Baffin Bay. Nutrient concentrations reflect a three layer structure similar to that defined by salinity and temperature. In the northern and central sections of the bay, nitrate and phosphate concentrations increase by about 50% with depth from below the upper layer to the bottom, whereas silicate levels increase nearly fourfold between these depths. It is suggested that nutrient concentrations can be used to label layer water masses with resolution similar to that provided by salinity and temperature. (Geiger-FRC)
W83-01772

CONCENTRATION AND SPECIATION OF DISSOLVED SUGARS IN RIVER WATER,
Portland State Univ., OR.
M. S. Sweet, and E. M. Perdue.
Environmental Science and Technology, Vol 16, No 10, p 692-698, October, 1982. 7 Fig, 4 Tab, 31 Ref.

Descriptors: *Sugars, *Rivers, *Carbohydrates, Organic carbon, Williamson River, Klamath Marsh, *Oregon, *Humic acids, Glucose, Marshes, Springs, Lakes, Watersheds, *Saccharides, *Dissolved sugars.

Total dissolved sugars concentrations in the waters of Williamson River basin, Oregon, varied from 0.1 to 7.7 micro M at 11 sites. The January to May 1979 sampling included waters from springs, a marsh, a lake, and streams. Pentoses comprised about 50% of the identified sugars. Arabinose, xylose, galactose, and glucose made up the remainder in about equal concentrations; mannose concentrations were very low. Sugar concentrations were lowest in spring water and highest in sites downstream of the marsh. Dissolved sugars accounted for about 2% of total organic carbon in the river system. Fractionation showed that humic-bound saccharides reached 6.5 micro M downstream from the marsh; the polysaccharides were highest (5 micro M) in the marsh sample. Monosaccharides concentrations were low, < 0.5 micro M. Monosaccharides averaged 2.6% of the total sugars; the remainder was equally divided between the other 2 fractions. The ratio of polysaccharides to humic saccharides was higher in lake and marsh samples than in stream samples. Glucose and other hexoses were enriched in the polysaccharide fraction and deficient in the humic saccharide fraction. (Cassar-FRC)
W83-01779

H2O2 LEVELS IN RAINWATER COLLECTED IN SOUTH FLORIDA AND THE BAHAMA ISLANDS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
R. Zika, E. Saltzman, W. L. Chameides, and D. D. Davis.
Journal of Geophysical Research, Vol 87, No 7, p 5015-5017, June, 1982. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Rainfall, *Chemical composition, *Hydrogen peroxide, *Florida, Miami, *Bahama Islands, Water analysis, Chemical analysis, Storms, Chemistry of precipitation.

Measurements were made of hydrogen peroxide in rainwater collected in Miami, Florida, and in the Bahama Islands. Concentrations ranged from .00001 to .00007 HM. No systematic trends in H2O2 concentration were observed during an individual storm, in marked contrast to the behavior of other anions such as nitrates, sulfates, and chlorides. The data suggest that a substantial fraction of the hydrogen peroxide found in the precipitation was generated by aqueous-phase reactions within the cloudwater rather than via rainout and washout of gaseous hydrogen peroxide. (Baker-FRC)
W83-01914

THE FREE RADICAL CHEMISTRY OF CLOUD DROPLETS AND ITS IMPACT UPON THE COMPOSITION OF RAIN,
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
W. L. Chameides, and D. D. Davis.
Journal of Geophysical Research, Vol 87, No 7, p 4863-4877, June, 1982. 8 Fig, 7 Tab, 73 Ref.

Descriptors: *Cloud physics, *Rainfall, *Chemical reactions, Chemical composition, Chemistry of precipitation, Free radicals, Clouds, Temperature effects, Hydrogen peroxide, Sulfate, Precipitation.

The significance of a chemical mechanism heretofore neglected in studies of cloud chemistry is cited as being significant in its impact on the chemistry of precipitation. The mechanism involves free radicals and reactive ionic species in the aqueous phase. Daylight hours involve scavenging by and incorporation into cloud droplets of OH and HO2 radicals from the gas phase. Once dissolved in cloudwater, these species can undergo rapid aqueous phase chemical reactions, leading to the generation of H2O2. The rapid oxidation of sulfur species dissolved in cloudwater by this free-radical-produced H2O2 as well as by aqueousphase OH radicals could conceivably have a significant impact on the chemical composition of rain. (Baker-FRC)
W83-01916

GRAPHICAL CALCULATION OF ION CONCENTRATIONS IN CALCIUM CARBONATE AND/OR GYPSUM SOIL SOLUTIONS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Suarez.
Journal of Environmental Quality, Vol 11, No 2, p 302-308, April-June, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Calcium carbonate, *Soil solution, *Graphical methods, Prediction, Gypsum, Ions, Irrigation effects, Chemical composition, Leaching.

There is an acute need for calculations of calcium concentrations in order to evaluate the soil chemistry of irrigated arid lands. However, existing methods for satisfactorily predicting the chemical composition of waters undergoing precipitation or dissolution of calcite and/or gypsum require computer models or entensive numerical calculations which are not convenient for use by such field personnel as water quality specialists and agricultural extension personnel. A new graphical method has been developed for calculating the equilibrium chemical concentration of waters undergoing calcium carbonate and/or gypsum dissolution or precipitation. The procedure requires the assumption that the water is in an open system with carbon dioxide, with the carbon dioxide level controlled

by respiration and diffusion and not influenced by carbonate dissolution and/or precipitation reactions. The procedure incorporates graphical representations of the solubility equations and curves representing the changes in concentration during precipitation or dissolution. The combination of the curves (drawn in concentrations) and solubility lines permits the calculation of equilibrium concentrations for any solution saturated with a calcium carbonate and/or gypsum phase. Corrections can be made for ionic strength and for ion complexation. The graphical procedures allow quick prediction of steady-state concentrations of major species in solution in the absence of ion exchange. Comparison of the results of this procedure with computer simulation showed that the graphical method gave comparable results when applied to various western U. S. irrigation waters and different leaching fractions. (Carroll-FRC)
W83-01971

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC SEPARATION AND SELECTIVE DETECTION OF ANIONIC SURFACTANTS. APPLICATION TO COMMERCIAL FORMULATIONS AND WATER SAMPLES,
Amsterdam Univ. (Netherlands). Lab. for Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W83-01984

MICROSAMPLE-FILTERING DEVICE FOR LIQUID CHROMATOGRAPHY OF FLOW INJECTION ANALYSIS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5A.
W83-02004

INTERFERENCES IN AUTOMATED PHENOL RED METHOD FOR DETERMINATION OF BROMIDE IN WATER,
Kansas Univ., Lawrence. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W83-02005

DETERMINATION OF PHOSPHORUS AT THE PARTS PER TRILLION LEVEL BY LASER-INDUCED THERMAL LENSING COLORIMETRY,
Tokyo Univ. (Japan). Dept. of Physics.
K. Fujiwara, W. Lei, H. Uchili, F. Shimokoshi, and K. Fuwa.
Analytical Chemistry, Vol 54, No 12, p 2026-2029, October, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Phosphorus, *Colorimetry, *Water analysis, Laser-induced thermal lensing colorimetry, Seawater, Lakes, Chemical analysis.

Determination of parts per trillion levels of phosphorus by the thermal lensing effect is discussed, along with signal processing by a personal computer. This method was applied to the analysis of phosphorus in seawater and lake water. An Ar+ laser-pumped rhodamine 101 laser was used as the heat and probe source. The signal from a silicon photocell with a 1 sq mm photosensitive surface, which was used as a laser radiation detector, was processed with an inexpensive personal computer. The detection limit is 5 pg of P/mL, which is set mainly by the deviation in the color development with the molybdenum blue method. The analytical results with seawater for two CSK standard solutions of 500 pg of P/mL were 495 and 485 pg of P/mL. The results for the lake water attest to the efficacy of this method for the detection of phosphorus at levels too low to be measured by conventional colorimetry. (Baker-FRC)
W83-02006

CONTINUOUS FLOTATION OF TRACE AMOUNTS OF NITRITE ION IN WATER,
Tokyo Metropolitan Univ. (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.
Analytica Chimica Acta, Vol 141, p 427-430, 1982. 4 Fig, 13 Ref.

Descriptors: *Nitrites, *Water analysis, *Pollutant identification, Water quality, Monitoring, *Spectrophotometry, *Flotation.

A flotation-spectrophotometric method is proposed for the determination of nitrite ion. All the solutions involved, including the sample, are pumped continuously, and the procedure is suitable for the determination of nitrite ion at the microgram/liter level in water. The nitrite (3-40 micrograms/liter) is continuously converted to an azo dye for spectrophotometric measurement at 15-minute intervals. Connection of an appropriate continuous photometric detector to this system will facilitate a continuous nitrite monitoring system. (Baker-FRC)
W83-02007

MICROSCALE FUNCTIONAL GROUP ANALYSIS OF MARINE AND SEDIMENTARY HUMIC SUBSTANCES,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W83-02008

CADMIUM(II) BINDING BY SOIL-DERIVED FULVIC ACID MEASURED BY ANODIC STRIPPING VOLTAMMETRY,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W83-02011

AUTOMATED DETERMINATION OF NITRATE IN WATERS WITH A REDUCTION COLUMN IN A MICROCOMPUTER-BASED STOPPED-FLOW SAMPLE PROCESSING SYSTEM,
Illinois Univ. at Urbana-Champaign. School of Chemical Sciences.
For primary bibliographic entry see Field 5A.
W83-02012

DETERMINATION OF MOLYBDENUM IN NATURAL WATERS AFTER SELECTIVE ADSORPTION ON SEPHADEX GEL,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W83-02013

DETERMINATION OF ARSENIC AND ANTIMONY IN GEOLOGICAL MATERIALS AND NATURAL WATERS BY COPRECIPITATION WITH SELENIUM AND NEUTRON ACTIVATION-GAMMA-SPECTROMETRY,
Dalhousie Univ., Halifax (Nova Scotia). Trace Analysis Research Centre.
For primary bibliographic entry see Field 5A.
W83-02014

ADSORPTION OF METAL IONS AND METAL COMPLEXES ON CLAY MINERALS: A STUDY OF THE NATURE OF BONDING BY X-RAY PHOTOELECTRON SPECTROSCOPY,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
For primary bibliographic entry see Field 1B.
W83-02058

WATERBORNE NUTRIENT FLOW THROUGHAN UPLAND-PEATLAND WATERSHED IN MINNESOTA,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
For primary bibliographic entry see Field 2D.
W83-02089

2L. Estuaries

GEOLOGY AND HYDROLOGY OF WETLANDS IN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
W. S. Motts, and A. L. O'Brien.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154419, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center, Pub No 123, Oct 1981, Univ. of Mass., Amherst. 147 p, 9 Tab, 23 Fig, 67 Ref, 3 Append. B-012-MASS(11), B-023-MASS(18). 14-31-0001-3090 and 3596.

Descriptors: *Wetlands, Geology, Hydrology, Groundwater, Groundwater basins, Available water, *Groundwater potential, *Geohydrology, *Groundwater recharge, Aquifers, Surface-groundwater relations, *Groundwater movement, Water supply, Potential water supply, Water management, Well capacity, Water table wells, Artesian wells, Well yield, Artesian basins, Confined groundwater, *Massachusetts, Topographic-groundwater-wetland relationships, Amherst.

The report provides detailed data on three Massachusetts wetlands of varying character in diverse settings. The findings reveal a wide range of differences between wetlands in the extent to which they (1) modify the character of runoff from a basin, (2) influence the discharge/recharge relationship with their underlying aquifer, and (3) affect potential ground-water development. Wetlands cover 6.5% of the land area of Massachusetts. Two thirds of the state's wetlands are underlain by potential aquifers in stratified drift and lake bottom deposits. There is good probability of penetrating high saturated thicknesses of stratified-drift aquifers near wetlands. Artesian aquifers which commonly underlie lakebed-type wetlands are protected from man-induced contamination by the wetland, the clay cap, and the aquifer artesian pressure. This report proposes a classification to define the hydrologic response of wetlands using factors of hydrologic position, geologic type, and topographic position. Important geologic and hydrologic factors include character and thickness of surficial materials; bedrock type; hydrologic position and connection of wetland-related aquifers including permeability of their organic layer, their transmissivity, and their quality; groundwater outflow; and depth of standing water. Important topographic factors are wetland position in the drainage basin and both their relative and absolute size.
W83-01795

A PRELIMINARY CHECKLIST OF MARINE BENTHIC DIATOMS OF MISSISSIPPI.
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
M. J. Sullivan.
Gulf Research Reports, Vol 7, No 1, p 13-18, December 1981. 1 Tab, 20 Ref. OWRT A-124-MISS(3), 14-34-0001-9026.

Descriptors: *Diatoms, *Systematics, Biogeography, *Salt marshes, *Soil algae, Ecological distribution, Aquatic habitats, *Mississippi, Marine algae, Sessile algae, Biological communities, Graveline Bay Marsh, Mississippi Sound, Seagrasses, Epiphytic algae, Species checklist.

A checklist of diatoms collected from various benthic habitats in coastal salt marshes and offshore seagrass beds of Mississippi has been compiled for the first time. The checklist includes 213 taxa (species and their varieties) in 43 genera with 19 of these taxa found only on the leaves of offshore seagrasses thus far. Synedra fasciculata var. intermedia (Grun.) Sulliv. comb. nov. is proposed to be consistent with the nomenclature of the nominate variety. Future work with this ecologically important group of marine algae should result in many new additions to this prelimanry checklist.
W83-01798

SIMILARITY OF AN EPIPHYTIC AND EDAPHIC DIATOM COMMUNITY ASSOCIATED WITH SPARTINA ALTERNIFLORA,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
M. J. Sullivan.
Transacitons American Microscopical Society, Vol 101, No 1, p 84-90, March 1982. 2 Tab, 18 Ref. OWRT A-133-MISS(4), 14-34-0001-1126.

Descriptors: *Diatoms, *Salt marshes, Biological communities, *Soil algae, *Sessile algae, *Rhodophyta, Ecological distribution, Marine algae, Aquatic habitats, *Mississippi, Community structure, Species diversity, Epiphytic algae, *Spartina, *Bostrychia, *Caloglossa, St. Louis Bay.

Diatoms were collected from the red algae Bostrychia radicans and Caloglossa leprieurii which were attached to dead stems of Spartina alterniflora and from sandy sediments in which the spermatophytes were rooted in St. Louis Bay, Mississippi. The dominant taxa in both communities were Anaulus balticus, Fragilaria atomus, F. pinnata, and Nitzschia minutula. The epiphytic and edaphic diatom communites possessed a surprisingly high degree of structural similarity as measured by SIMI, despite the fact that diversity was higher in the sediments. This higher diversity characterizing edaphic diatom communities may be a general phenomenon in the marine environment and may be a result of the stabilization of surface sediments by mucilage-secreting pennate diatoms.
W83-01799

PHYTOPLANKTON PRODUCTIVITY, RESPIRATION, AND NUTRIENT UPTAKE AND REGENERATION IN THE POTOMAC RIVER, AUGUST 1977-AUGUST 1978.
Geological Survey, Menlo Park, CA.
Available from OFSS, USGS Box 25425, Fed Ctr, Denver, CO 80225. Paper copy $6.50, Microfiche $3.50. Geological Survey Open-File Report 81-700, May 1981. 51 p, 3 Fig, 6 Tab, 25 Ref. Cole, B. E. and Harmon, D. D., ed.

Descriptors: *Bays, *Estuaries, *Data collections, Phytoplankton, Respiration, Nutrients, Regeneration, Carbon, Hydrogen, Ion concentration, Dissolved oxygen, Potomac River estuary.

Rates of phytoplankton productivity, respiration, and nutrient uptake and regeneration are presented. These observations were made on the Potomac River estuary (POTE) during four cruises between August 1977 and August 1978. Four experimental methods were used: carbon uptake using carbon-14, carbon uptake and respiration by a pH method, productivity and respiration by the dissolved oxygen method, and nutrient (NH_4^+, NO_3^-, NO_2^-, $PO_4^=$, and $SiO_2^=$) uptake and regeneration by colorimetry. The experiments were made at sites representative of conditions in four principal reaches of the tidal Potomac River estuary: near the mouth, seaward of the summer nutrient and phytoplankton maximum, near the region of maximum phytoplankton standing stock, and near the maximum anthropogenic nutrient source. (USGS)
W83-01848

SEDIMENTATION AND APPARENT SEA-LEVEL RISE AS FACTORS AFFECTING LAND LOSS IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. H. Baumann, and R. D. DeLaune.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 2-13, 5 Fig, 14 Ref.

Descriptors: *Sea level, *Wetlands, *Marshes, *Sedimentation rates, *Aggradation, *Estuaries, *Louisiana, Coastal marshes, Salt marshes, Accretion, Deltas.

Rates of apparent sea-level rise and marsh aggradation were determined with the aid of Cs-137 dating, artificial marker horizons, and water level data for the lower Barataria and Calcasieu estuaries. The two study areas are repesentative of the two coastal regions of Louisiana: the chenier and Mississippi deltaic plains. The site within the chenier plain is a brackish to saline Spartina patens marsh known locally as the East Cove marsh, located on the south shore of Calcasiu Lake. The deltaic plain site is the saline Spartina alterniflora marsh surrounding Barataria Bay. These marshes are not vertically accreting at a rapid enough rate to maintain their intertidal elevation and have been subject to net submergence since at least the mid 1950's. This has resulted in a conversion of marsh to open water habitats. Rates of apparent sea-level rise at the two study areas were 1.2 and 1.3 cm/yr from 1954 to present. Sedimentation rates through the same period were approximately 0.7 cm/yr over most of the area of investigation, though streamside marshes aggraded at a rate of 1.35 cm/yr. The transformation of marsh to open water will be complete in a few decades if present trends continue. (Moore-SRC)
W83-01863

MUDFLAT AND MARSH PROGRADATION ALONG LOUISIANA'S CHENIER PLAIN: A NATURAL REVERSAL IN COASTAL EROSION,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
J. T. Wells, and G. P. Kemp.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 39-51, 6 Fig, 16 Ref.

Descriptors: *Mud flats, *Coastal marshes, *Sedimentation, *Accretion, *Coasts, *Atchafalaya River, *Louisiana, Suspended sediments, Deltas, Chenier plain, Aggradation.

The chenier plain coast of southwestern Louisiana has beeen receiving sediment intermittently from the Mississippi River for the last 5,000 years. A new influx of fine-grained sediment, the first such sediment pulse in perhaps 500 to 1000 years, is leading to localized coastal progradation along what has historically been one of the most rapidly retreating shorelines in the United States. Carried as suspended sediment by the Atchafalaya mud stream, silts and clays from the Atchafalaya River are now accumulating as mudflats along a segment of coast from Freshwater Bayou Canal to Rollover Bayou. These transitory mudflats provide a buffer to incoming storm waves and serve as a temporary storehouse for littoral sediments. Process-oriented field studies initiated in 1980, together with satellite imagery, color infrared photography, and aerial overflights since 1974, are providing insight as to present and future trends in sedimentation. Growth of the chenier plain appears initially to be by a series of transitory mudflats, a few of which become welded to the shoreline. Since 1969 the pattern of mudflat sedimentation has been increasing and shifting to the west, consistent with the direction of coastal and wave-induced currents. Accelerated growth of the chenier plain is expected when the subaerial Atchafalaya Delta outgrows Atchafalaya Bay, thus allowing an even greater volume of sediments to enter the dynamic shelf region seaward of the bay and to become entrained in the bay and to become entrained in the mud stream. The time scale for widespread reversal in present coastal erosion is 50 to 100 years. (Author's abstract)
W83-01864

EFFECTS OF WETLAND DETERIORATION ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,
Fish and Wildlife Service, Lafayette, LA.
For primary bibliographic entry see Field 6G.
W83-01867

REVERSAL OF COASTAL EROSION BY RAPID SEDIMENTATION: THE ATCHAFALAYA DELTA (SOUTH-CENTRAL LOUISIANA),
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 2J.
W83-01869

ON THE REPRESENTATION OF REYNOLDS STRESS IN ESTUARIES AND SHALLOW COASTAL SEAS,
University Coll. of Swansea (Wales). Dept. of Civil Engineering.
T. J. Smith.
Journal of Physical Oceanography, Vol 12, No 8, p 914-921, August, 1982. 8 Fig, 19 Ref.

Descriptors: *Model studies, Hydrodynamics, *Flow characteristics, *Estuaries, *Turbulent flow, *Shallow water, Mathematical studies, Mathematical models, Tidal hydraulics, Eddy diffusion, *Reynolds number, Steady flow, Coastal waters, Stress, England, Humber Estuary.

A model is derived for simulating the Reynolds-stress tensor in three-dimensional hydrodynamic models of shallow water flows in estuaries and shallow coastal seas. The model combined the accuracy of turbulence-energy closure schemes with the computational efficiency of algebratic eddy viscosity models. The model assumes the eddy-viscosity tensor to have structural similarity, from which it is shown that its magnitude is scaled on the depth-mean turbulence energy and the depth-mean turbulence-energy dissipation rate. The vertical structure is decribed by a similarity function, of which two alternatives are derived. Similarity assumptions used in the analysis are verified. the model was applied to both steady and tidal flows. (Geiger-FRC)
W83-01913

SELF-SIMILAR PARTICLE-SIZE DISTRIBUTIONS DURING COAGULATION: THEORY AND EXPERIMENTAL VERIFICATION,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
For primary bibliographic entry see Field 8B.
W83-01992

RESIDUES OF O,P'-DDT IN SOUTHERN CALIFORNIA COASTAL SEDIMENTS IN 1971,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5B.
W83-02025

AN ECOLOGICAL CHARACTERIZATION OF THE LOWER EVERGLADES, FLORIDA BAY AND THE FLORIDA KEYS,
Florida State Dept. of Environmental Regulation, Tallahassee.
N. S. Schomer, and R. D. Drew.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-82/52.1, September 1982. 263 p, 62 Fig, 5.1 Tab, 360 Ref. 14-16-009-80-999.

Descriptors: *Wetlands, *Estuaries, *Mangrove swamps, *Salt marshes, *Wildlife, *Ecology, *Florida, Hydrology, Water chemistry, Climate, Watersheds, Salinity, Distribution, Substrates, Marshes, Environmental effects.

A conceptual model of the study area identifies four major ecological zones; terrestrial and freshwater wetlands; Florida Bay and mangrove islands; and the Florida Keys. These are geographically delineated from one another by a combination of elevation gradient and positioning relative to one another and to major outside influences such as upstream watersheds, the continental shelf and major ocean current systems. These zones are delineated by differences in basic physical-chemical background factors such as substrate, climate, hydrology and water chemistry which in turn promote characteristic ecological communities. The terrestrial and freshwater wetlands support pinelands, sawgrass marshes, wet prairies, sloughs and occasional tree islands on freshwater peat, marl and limestone soils. The estuarine and saltwater wetlands support mangrove forests, salt marshes and oscillating salinity systems on mangrove peat, marine marl, sand or 'liver mud' substrates. Florida Bay exhibits oscillating meso-to hypersaline waters over grassbeds on marine lime mud sediments. These mud banks form an anastomosing pattern surrounding deeper 'lake' areas having only a thin veneer of sediment. The exposed tips of the mud banks frequently support mangrove or salt prairie vegetation. The Florida Keys support almost all of the above communities to some small degree but

are more prominently characterized by extensive offshore coral reefs. The productivity of these communities with regard to fish and wildlife reflects: the diversity and type of habitats available to species that are potentially capable of exploiting them; the degree of alteration of these habitats by man and natural forces; and historical, biogeographic and random factors that restrict organisms to specific environments or prohibit them from exploiting a potential habitat. (Moore-SRC)
W83-02036

MATAGORDA BAY, TEXAS: ITS HYDROGRAPHY, ECOLOGY AND FISHERY RESOURCES,
Espey, Huston and Associates, Inc., Austin, TX.
G. H. Ward, and N. E. Armstrong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-138750, Price codes: A15 in paper copy, A01 in microfiche. Fish and Wildlife Service, Biological Services Program Report FWS/OBS-81/52, January 1980. 246 p, 126 Fig, 45 Tab, 970 Ref, 1 Append. 14-16-0009-78-066.

Descriptors: *Estuaries, *Hydrography, *Wildlife, *Fisheries, *Watershed management, *Ecosytems, Texas, Resources development, Ecology, Bays, Estuarine environment, Salinity, Dissolved oxygen, Water temperature, Nutrients.

The Matagorda Bay system is one of the principal embayments on the Texas coast. In recent years the Matagorda Bay area and watershed have been subjected to increasing development, and is therefore becoming subject to management problems equivalent to those in other principal Texas embayments. Those problems include the resolution of the stresses imposed by municipal and industrial developments in the bay area, especially the use of water upstream in the drainage basins, with the requirements for sustaining the bay's ecosystem. The functioning of the estuarine ecosystem is sensitive to the distributions of waterbourne constituents such as salinity, dissolved oxygen, temperature and nutrients, which are influenced directly by the alterations to the bay attending development, especially modification of the freshwater inflow. The overall goal of this study is the identification, compilation, and synthesis of hydrographic and biological information in order to assess the fish and wildlife resources of the Matagorda Bay area and to delineate the dependency of these resources upon the hydrographic characteristics of the bay. In order to analyze the Matagorda Bay system and to arrive at operationally useful conclusions within the time frame of the study, an indicator approach was adopted. The indicators for the biological system are 25 key species selected to represent major elements of the bay biological communities. These key species include three seagrasses, seven marsh plants, four shellfish and eleven finfish. The indicator hydrographic-chemical parameters are temperature, salinity, dissolved oxygen and depth. (Moore-SRC)
W83-02037

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HONULULU OFFERS EFFLUENT-FOR-WATER-SWAP.
World Water, Vol 5, No 9, p 35, September, 1982. 1 Fig.

Descriptors: *Water supply, *Water demand, *Water resources development, Water reuse, Desalination, Wastewater treatment, Drinking water, Potable water, Irrigation, Membranes, *Hawaii, Honolulu, Groundwater.

Due to sudden and significant population growth the Board of Water supply for Honolulu is concerned with its sources of water supply. The volcanic island of Oahu contains vast groundwater reserves. However, total demand on the island will exceed supply by the end of the century. The prime candidate for easing the situation is a wastewater reuse system, which may free some of the potable water currently soaked up by the sugar cane plantations at the rate of more than 90,000 liters/ha. Another idea for increasing potable supplies is currently being examined using inpermeable membrane as a barrier to trap the fresh water which currently flows into the West Loch of Pearl Harbor, just to the west of Honolulu. Different configurations of membrane are possible. Initial research with hydraulic models has proved promising. A blending of brackish and fresh water to an acceptable chloride level, demineralization of electrodialysis and reverse osmosis, and the use of OTEC ocean thermal energy to produce a fresh water byproduct are being considered. (Baker-FRC)
W83-01818

DRAINAGE AND DESALINIZATION OF HEAVY CLAY IN PORTUGAL,
Direccao Geral de Hidraulica e Engenharia Agricola, Lisbon (Portugal).
For primary bibliographic entry see Field 3C.
W83-02022

RESEARCH AND DEVELOPMENT ON SPIRAL-WOUND THIN-FILM COMPOSITE MEMBRANE SYSTEMS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
R. L. Riley, and C. E. Milstead.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167825, Price codes: A07 in paper copy, A01 in microfiche. Report, September 17, 1982. 134 p, 32 Fig, 36 Tab, 7 Ref. OWRT C-10062-D(1481)(1), 14-34-0001-1481.

Descriptors: *Reverse osmosis, *Membrane processes, *Desalination, *Chlorine, *Sodium bisulfite, *Trihalomethanes, Bromoform, Demineralization, Halogenated hydrocarbons.

Single-stage desalination of seawater by reverse osmosis requires a membrane which approaches theoretical semipermeability and is sufficiently thin to provide transport of water at practical operating pressures and recovery rates. This objective has been achieved by the development of a family of thin-film composite membranes (TFC) based on nitrogen-containing polymers supported on a fabric reinforced porous supporting membrane. Long-term tests on both cellulose acetate and TFC membrane elements were conducted to determine the effect of trihalomethanes, primarily bromoform, on membrane flux. Both membrane types showed significant flux decline in the presence of part per million quantities of bromoform in a Yuma feed solution. In the part per billion range, minimal flux decline was observed. This indicates that the presence of bromoform in the aqueous phase of the membrane is primarily responsible for the observed flux decline. The use of sodium bisulfite as a reducing agent for chlorinated feed streams has periodicaly been blamed for membrane failure due to the instability of the TFC membrane to bisulfite. Long-term tests conducted with concentrations of sodium bisulfite up to 1500 ppm added to the feed indicated that continuous exposure of TFC membrane systems to low levels of sodium bisulfite should not adversely affect system performance. Long-term field testing of spiral-wound TFC membrane elements at the test facility at Wrightsville Beach, North Carolina, was generally inconclusive since membrane damage due to the frequent presence of chlorine in the feed water precluded obtaining meaningful performance data. (Moore-SRC)
W83-02052

FURTHER TESTING AND DEVELOPMENT OF CONCENTRATION POLARIZATION CONTROL BY ACCELERATION,
SRI International, Menlo Park, CA. Engineering Sciences Lab.
J. C. Eid, and G. B. Andeen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167833, Price codes: A10 in paper copy, A01 in microfiche. Report, October 1982. 219 p, 16 Fig, 13 Tab, 15 Ref. 1 Append. OWRT C-10005-S (No 1438)(1), 14-34-0001-1438.

Descriptors: *Reverse osmosis, *Membrane processes, *Desalination, *Particulate matter, *Acceleration, Demineralization, Water treatment, Wastewater treatment, Salts, Concentration polarization.

Experimental data show that acceleration is effective in reducing two of the major problems of reverse osmosis: concentration polarization and particulate fouling. In tests using feed solutions of sodium chloride in varying concentrations. The application of acceleration up to 500 g caused permeate flow increases and salt flow reductions up to 13% in commercial hollow-fiber elements and up to 21% in spiral-wound elements. This indicates a reduction in concentration adjacent to the membrane and provides a margin of safety from precipitation fouling on the brine side of the membrane. The effects of acceleration on particulate fouling were determined by using a solution of 40-ppm iron hydroxide in 0.5% sodium chloride. The processed data indicate an assymptotic decline in desalinate flow with time. The application of 500 g of acceleration allowed a fouled membrane to produce 92% of the membrane's unfouled desalinate flow, whereas the same membrane in a non-accelerated state produced as little as 62% of its unfouled desalinate flow. The capability to reduce concentration polarization and particulate fouling has many advantages; reverse osmosis may be able to deal with more difficult fluids, the use of higher flux membranes is possible, and membrane and pretreatment costs may be reduced. (Moore-SRC)
W83-02053

DESALINATION PLANTS: BETTER WAYS TO MEASURE AND CONTROL PH THROUGH IMPROVED MAINTENANCE AND TRAINING,
F. E. Moore.
Industrial Water Engineering, Vol 19, No 2, p 26-28, March/April, 1982. 4 Fig, 2 Ref.

Descriptors: *Desalination, *Acidity, *Maintenance, Water treatment, Purification, Reverse osmosis, Hydrogen ion concentration, Desalination plants.

Desalination plants are vulnerable to maintenance problems. Some troubles are blamed on poor pH measuring equipment. However, the quality of the equipment is not the central issue. Instead, it is the lack of attention paid to routine maintenance procedures and operator training. Once these needs are met, the life of a desalination plant can be extended significantly. A survey was completed of the full membership of the International Desalination and Environmental Association. All of the respondents indicated that above-average maintenance was needed with pH probes. Most respondents experienced little trouble with reference electrodes, but one-third indicated that they had coating trouble with the glass measuring electrode. About half the respondents used automatic control. (Baker-FRC)
W83-02084

3B. Water Yield Improvement

RELATIVE IMPORTANCE OF GROUNDWATER AND SURFACE-WATER SUPPLIES TO OIL-SHALE DEVELOPMENT, PICEANCE BASIN, COLORADO,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6D.
W83-01854

3C. Use Of Water Of Impaired Quality

UTILIZATION OF WASTEWATER FOR INTENSIVE FISH CULTURE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
H. E. Johnson, and D. J. Duffield.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154351, Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, Michigan State University, East Lansing, September 1980. 34 p, 3 Fig, 5 Tab, 36 Ref, 1 Append. OWRT A-082-MICH(2), 14-31-0001-5022.

Descriptors: *Fish culture, *Wastewater system, Nutrient recycle, Toxic residues, Food supply, *Channel catfish, *Catfish farming, *Michigan, Catfish ponds.

Channel catfish were reared in 0.8 m super 3 cages in southern Michigan farm pond and a pond which received secondary treated domestic wastewater. Cages were stocked in May with 117 mm fingerlings at densities of 50, 100 and 150 fish per cubic meter. The fish production in the farm pond was approximately 44.8 kg/m super 3 compared with 12.5 kg/m super 3 in the wastewater pond. The lower production in the wastewater pond was probably due to adverse water quality conditions including high pH, low dissolved oxygen and high concentrations of unionized ammonia. Total mortality of the fish in the wastewater pond occurred in September when dissolved oxygen levels declined to less than 1.0 mg/l. Fish production was not significantly affected by different stocking densities. The results indicate that cage culture is not suitable in highly enriched wastewater ponds with extensive plant growth but successful cage culture may be practiced in southern Michigan farm ponds.
W83-01788

THE GROWTH AND PRODUCTION OF MOCAMBIQUE TILAPIA (OREOCHROMIS MOSSAMBICUS) FED ON ALGAE IN SMALL TANKS,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
I. G. Gaigher.
Water SA, Vol 8, No 3, p 142-144, July, 1982. 2 Tab, 12 Ref.

Descriptors: *Aquaculture, *Algae, *Fish food, Wastewater treatment, *Fish ponds, *Tilapia.

Suspended algae from small high-rate algal culture ponds were fed to tilapia (Oreochromis mossambicus) during the periods of 43 and 115 days. Each 225 liter tank received 20 liters of 200-500 mg per liter algal suspensions. Growth was slow, 0.05-0.2 g per fish daily, and was adversely affected by overcrowding. Calculated stocking densities were 222,000 to 444,000 fish per ha; total biomass, 5.4-13.7 tons per ha; and production over 43 days, 1.1-2.5 tons per ha. The low growth rates were attributed to poor conversion of algae and invertebrates, overcrowding, buildup of excretory products between the weekly tank cleanings, and spawning in 3 of the 4 tanks. (Cassar-FRC)
W83-01827

CLOSED CYCLE INDUSTRIAL WASTES CONTROL,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 5G.
W83-01843

GRAPHICAL CALCULATION OF ION CONCENTRATIONS IN CALCIUM CARBONATE AND/OR GYPSUM SOIL SOLUTIONS,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2K.
W83-01971

WATER REGIME AND NITROGEN FERTILIZATION FOR RHODES GRASS IRRIGATED WITH MUNICIPAL WASTE WATER ON SAND DUNE SOIL,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 5E.
W83-01975

AMMONIA-OXIDIZING BACTERIA POPULATIONS AND ACTIVITIES IN SOILS IRRIGATED WITH MUNICIPAL WASTE WATER EFFLUENT,
Kimberly-Clark Corp., Neenah, WI.
For primary bibliographic entry see Field 5E.
W83-01976

PREDICTED SOLUTION PHASE FORMS OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
For primary bibliographic entry see Field 5E.
W83-01977

SOLID PHASE FORMS OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
For primary bibliographic entry see Field 5E.
W83-01978

DISPOSAL OF FEEDLOT LAGOON WATER BY IRRIGATING BROMEGRASS: I. CROP REMOVAL OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W83-01981

CHALK POINT: A CASE STUDY OF THE IMPACT OF BRACKISH WATER COOLING TOWERS ON AN AGRICULTURAL ENVIRONMENT,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5C.
W83-01982

YIELDS OF BAJRA AND WHEAT WITH SALINE WATERS APPLIED THROUGH SPRINKLER AND SURFACE IRRIGATION METHODS,
Haryana Agricultural Univ., Hissar (India).
M. C. Agarwal, R. Singh, S. K. Varma, and K. Singh.
Annals of Arid Zone, Vol 21, No 1, p 9-14, March, 1982. 2 Tab, 13 Ref.

Descriptors: *Irrigation, *Saline water, *Crop yields, *Wheat, *Bajra, Irrigation systems, Water conservation, Water resources development, Water supply, India, Hissar, Sprinkler irrigation.

Field experiments were conducted during kharif and rabi seasons of 1975 to 1978 at Haryana Agricultural University's Research Farm, Hissar, to study the effects of saline water applied through sprinkler and surface methods of irrigation on the performance of bajra and wheat crops and salt accumulation in soil. The results showed that saline water of 11.0 mmhos/cm EC applied by sprinkler reduced bajra yield by 33% but that of wheat by only 3%. Saline water up to 6.0 mmhos/cm EC can be safely applied to bajra by sprinkler in late evening or night hours. The marked reduction in bajra yield with application of 11.0 mmhos/cm EC through sprinklers was mainly due to burning of leaves caused by excessive sodium content in water. This water did not cause comparable damage to the same extent to the wheat crop because of this lower temperatures and higher relative humidity prevailing in the rabi season than in the kharif season. In sprinkler irrigated plots, the salt accumulation in the soil profile was 30-40% less in comparison to surface irrigation. The study showed that the use of highly saline water with sprinkler can be exploited for winter season wheat crops, but its use for summer season crops such as bajra is not feasible. (Baker-FRC)
W83-01999

DRAINAGE AND DESALINIZATION OF HEAVY CLAY IN PORTUGAL,
Direccao Geral de Hidraulica e Engenharia Agricola, Lisbon (Portugal).
M. Mann, A. Pissarra, and J. W. Van Hoorn.
Agricultural Water Management, Vol 5, No 3, p 227-240, 1982. 5 Fig, 11 Tab, 10 Ref.

Descriptors: *Soil treatment, *Saline soils, *Drainage effects, Clays, Gypsum, Leziria Grande, *Portugal, Soil management, Soil physical properties, Soil water, Drainage systems, Subsurface Drainage, Infiltration, *Desalination, Hydraulic conductivity, Groundwater management, Water management, Water table.

Three experimental fields were laid out on saline to very saline heavy clay soils in the Leziria Grande area of Portugal to evaluate methods for improving drainage and desalinzation. Subsurface drains were 1 m deep and 10 and 15 m apart in Field 1; 10, 15, and 20 m in Fields 2 and 3. Surface drains 0.6 m deep and 20 m apart, were installed on parts of Fields 2 and 3 in place of subsurface drains. During the first 3 years (autumn 1976 - spring 1979) rainfall (600-750 mm) exceeded evaporation, leading to drain outflow (250 mm) and desalinization, but during autumn, 1979-spring 1981 rainfall was $<$ 450 mm, producing no drain outflow. All subsurface drainage arrangements were more effective in lowering the groundwater table than surface drainage. Closer drain spacing lowered the groundwater table more rapidly than greater spacing. Subsurface drainage resulted in lower peak discharges (10-20 mm per day) and higher basic discharge rates than surface drainage (peak, 46 mm per day). No effect of drain spacing was observed on the discharge rate or on the total amount of drainage water. Leaching of salts decreased with time over 3 years. Gypsum was applied at 10 t per ha per year for 4 years on Field 1 and on half of Fields 2 and 3. This treatment lowered sodicity and increased infiltration rate and drain outflow. Total amounts of salts in drain water from gypsum plots were 40% higher than in untreated plots. However, no lower soil salinity values were found. Only 20-40% of applied gypsum was actually utilized. (Cassar-FRC)
W83-02022

3D. Conservation In Domestic and Municipal Use

SURVEY OF THE WATER CONSERVATION PROGRAMS IN THE FIFTY STATES: MODEL WATER CONSERVATION PROGRAM FOR THE NATION,
Environmental Policy Inst., Washington, DC.
B. Blackwelder, and P. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167866, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, August 1982. 140 p, 30 Tab, 25 Ref, 2 Append. OWRT C-10010-C(1437)(1), 14-34-0001-1437.

Descriptors: Conservation, *Water use, Water supply systems, Costs, *Drought, Water conveyance, Groundwater management, Economic aspects, *Reuse, *Industrial water use, *Municipal water use, Water metering, Water costs, Water scarcity, Water rates, *Water demand, Water storage, Water yield, *Irrigation, Irrigation programs, Groundwater, Water treatment, Water table, Water permits, *Water conservation, *Water policy, *State jurisdiction.

A survey was made of the water conservation programs in each of the fifty states to determine whether each state had a water conservation program or requirement in each of the following thirteen areas: public education, plumbing codes, retrofitting with flow-water-use fixtures, metering, leak detection, rate structures, drought contingency planning, reuse and recycling, outdoor use, groundwater management, industrial use, agricultural use, and government buildings and grants. A brief description of statewide or local programs of significance was prepared for each state. While awareness of water conservation measures is increasing, there is still substantial room for increases in efficiency in water use. The most comprehensive programs are being carried out in California, Massachusetts, Minnesota, and Maryland. Drawing upon the most succesful water conservation programs around the country, we prepared a model water conservation program for domestic and municipal use, industrial use, and agricultural use. Our model program can cut domestic and municipal

use between 15% and 70%. The model program for undustrial use categorizes various methods for reducing undustrial withdrawals and consumption of water and outlines success stories in the steel, chemical, and paper industries. The model program for agricultural use identifies the various techniques for improving the efficiency of water use, describes the potential savings from instituting such measures, points out barriers to efficient use, and suggests ways to overcome the barriers.
W83-02056

THE IMPACT OF WATER SYSTEM PRICING ON CONSUMPTION AND CONSERVATION,
Mississippi Univ., University. Bureau of Business and Economic Research.
W. E. Boyet, K. W. Hollman, S. C. Shull, and C. W. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167924. Water Resources Research Institute Completion Report, Mississippi State University, Mississippi State, September 1982. 79 p, 41 Tab, 18 Ref, 1 Append. OWRT B-026-MS(1), 14-34-0001-1238.

Descriptors: *Water conservation, *Pricing, *Water rates, *Water consumption, Economic impact, *Elasticity of demand, *Water costs, Elasticity of supply, *Mississippi, Southeast US, Northeast US, North Central US, Utilities.

An attempt was made to determine the impact of water pricing policies of water utilities on water consumption. Areas included in the study were the state of Mississippi, and states from the North Central, Northeastern, and Southeastern United States. Of particular interest was the constraining effect on consumption of constant or inclining block prices in contrast to the typical declining block price structure. The study found that most of the water systems in the Eastern part of the United States follow pricing schedules that offer little conservation incentive. Data for the study were obtained by questionnaire in Mississippi and from data published by the AWWA for the other regions. Two stage least squares was used to derive both algebraic-linear and log-linear equations for demand, price, and metered customers for the four areas. Water price elasticities for the three major geographic regions indicated that uniform price systems should experience a much more elastic demand response to price chages than systems with declining block prices. Price elasticities for Mississippi were the reverse, however, perhaps due to its rural nature. The results of the study support the hypothesis that constant or inclining water rate schedules tend to encourage water conservation.
W83-02062

3E. Conservation In Industry

SURVEY OF THE WATER CONSERVATION PROGRAMS IN THE FIFTY STATES: MODEL WATER CONSERVATION PROGRAM FOR THE NATION,
Environmental Policy Inst., Washington, DC.
For primary bibliographic entry see Field 3D.
W83-02056

EVALUATION OF CORROSION IN PULP AND PAPER MILL WHITE WATER REUSE APPLICATIONS,
Mississippi State Univ., Mississippi State. Dept. of Chemical Engineering.
G. R. Lightsey, W. B. Hall, and H. A. Koelling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167874, Price codes: A03 in paper copy, A01 in microfiche. Report OWRT/RU-82/16, October 1, 1982, 32 p, 9 Tab, 6 Fig, 23 Ref. OWRT C90322-R(1), 14-34-0001-9439.

Descriptors: *Corrosion control, *Water resuse, *Pulp and paper industry, Corrosion, *White water, *Pulp wastes, *Metals corrosion, *Recycling, *Stainless steel, Tafel Plot Method, Thermal stress, Corroison stress, Corrosion pitting, Mechanical stress.

The purpose of this research was to develop data for predicting the rates of corrosion of common metals at various levels of white water reuse in pulp and paper mill. The white water at a kraft pulp and paper mill was characterized in terms of physical properties that are known to have potential corrosion hazards. Among the physical properties measured were temperature, conductivity, chloride concentration, hardness, sulfate concentration, pH, barium concentration, and sodium concentration. The corrosivity of the white water at various white water recycle rates was determined in the laboratory and under actual mill conditions. Both stressed and unstressed metal coupons were placed in the mill white water and in simulated white water laboratory. The uniform corrosivity, as determined by the Tafel Plot Method, of 304L stainless steel in the laboratory-simulated white water at recycle rates from 80% to 92% was found to be very low. Measurement of the pitting corrosion and stress corrosion of 304L stainless steel both in the laboratory and under mill conditions showed that mechanical stresses had little effect on either the pitting or stress corrosion. However, thermal stresses, in the form of unannealed welds, significantly increased the pitting corrosion in the heat-effected zones of the metal.
W83-02057

3F. Conservation In Agriculture

DEVELOPMENT AND APPLICATION OF ALLOCATION CRITERIA FOR WATER USES AND USERS IN MAXIMIZING VALUE PRODUCTIVITY OF WATER SUPPLIES,
Iowa State Univ., Ames. Dept. of Economics.
J. Timmons.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167569, Price codes: A03 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Ames, ISWRRI Report No 104, December 1982. 24 p, 8 Ref. OWRT A-067-IA(1), 14-34-0001-8017.

Descriptors: *Supplemental irrigation, Economic aspects, *Iowa, *Groundwater sources, Aquifers, Pumping costs, Linear programming, Alluvial aquifers, Dakota Sandstone Aquifer, *Irrigation costs, Model studies, Cost estimates, Crop yield, *Cost comparisons.

Three case studies of irrigation profitability in northwestern Iowa are summarized in this report. Two possible sources of groundwater for irrigation was considered: The Alluvial Aquifers, which have relatively lower cost of pumping water; and the Dakota Sandstone Aquifer, which has a higher cost of pumping water. The linear programming model also considered three irrigation systems (a center pivot system, a gated pipe system, and a travelling gun system) and three different tillage systems. Irrigation from the Alluvial Aquifers appeared to be profitable. At lower interest rates the center pivot system was found to be preferable over the other two methods, while at high interest rates the gated pipe system, which does not require big initial capital, was preferred. Irrigation from the Dakota Sandstone Aquifer was found to be not feasible in an average year. A multiperiod linear programming model was used to analyze investments in irrigation and four other alternatives: 1) U.S. 4-6 month treasury bills: 2) grade Bbb corporate bonds; 3) high grade municipal bonds; and 4) land as a source of rental income. The rate of return from irrigation was the least of the five options considered. The study also concluded that irrigation does not completely eliminate yield and income fluctuations from weather variability. Techniques for predicting yield increases from irrigation and methods for estimation of the cost of irrigation were developed for eight forms in the study area. Marginal value product curves as more acres are brought in to irrigation were derived. It was concluded that irrigation was an unprofitable venture on the average soil.
W83-01953

POTENTIAL OF DRIP IRRIGATION IN ROW CROPS FOR AGRICULTURE WATER CONSERVATION IN CALIFORNIA,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. O. Pruitt, D. W. Henderson, E. Fereres, and R. M. Hagan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167577, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, January 1983, 45 p, 13 Fig, 2 Tab. OWRT A-076-CAL(1).

Descriptors: *Water conservation, *Furrow irrigation, *Drip irrigation, Yield, *Tomatoes, *California, Irrigation management, Irrigation efficiency, Irrigation effects, *Irrigation practices, Irrigation, *Evapotranspiration, Microclimates.

Results are presented of a two year study comparing the evapotranspiration (ET), yields and the microclimate under drip and furrow irrigated processing tomatoes. Results from a water conservation standpoint were not encouraging with approximately equal values of evapotranspiration found for the two methods of irrigation. This was true in replicated field pilot studies as well as the lysimeter studies. The latter studies indicate that although ET under furrow irrigation was considerably higher than under drip irrigation for the three days following each furrow irrigation, this advantage is largely cancelled by a reversal in trends thereafter. Apparently the advection of sensible heat in air and soil to the narrow wet strips under the drip-irrigated canopy produces quite significant evaporation losses in spite of a nearly zero under-canopy radiation. Yield of ripe fruit in the drip irrigated lysimeter exceeded yields in the furrow lysimeter by 9% and 16% respectively in 1979 and 1980. In the replicated field-plot study yields in 1979 were not significantly different between regular drip and furrow irrigated treatment. Yields for the three treatments were respectively 83.8, 66.2, and 58.6 tons per hectare. (Snyder-California)
W83-01954

CROP YIELDS AS INFLUENCED BY RUN-OFF AND SOIL MOISTURE STORAGE,
Central Arid Zone Research Inst., Jodhpur (India).
B. L. Jain, and R. P. Singh.
Annals of Arid Zone, Vol 21, No 1, p 19-23, March, 1982. 3 Tab, 3 Ref.

Descriptors: Water supply, *Crop yield, *Arid zone, *Rainfall-runoff relationships, Farming, Water resources development, *Soil moisture. *India, Pali-Marcoar.

Field trials were carried out for four consecutive years involving micro-catchments having a runoff to run-on ratio of 1:0.75, with a cultivated area of 43% of the total land. Micro-catchments having varying slopes (4, 6, and 8%) and treated differently (bare, tank silt, and bentonite clay) were prepared before the rainy season of 1974. In general, microcatchments, irrespective of slope, provided 50-80% additional run-off to the run-on (cultivated) strips. Runoff yields from micro-catchments having slopes of 4-8% and treated with bentonite clay and tank silt were 4-6% higher as compared to bare micro-catchment. During 1974 only 140 mm rainfall was received during the cropping season. Under control treatment green gram and castor beans failed to give a harvest. However, under the run-off farming treatments, these crops gave a harvest. Even in years where the rainfall was normal some crops still had greater yields due to the extra benefits of the run-off farming scheme. Moisture content of the soil profile in the run-on plots was relatively higher because of additional run-off received from the adjacent run-off strips. In the event of a drought, complete crop failure can be averted by following the run-off farming system. (Baker-FRC)
W83-02000

EFFECT OF MULCHES AND ANTITRANSPIRANTS ON THE GROWTH AND YIELD OF SUNFLOWER EC 68414 UNDER LIMITED WATER SUPPLY,
College of Agriculture, Anand (India).
U. M. Damor, and V. D. Mane.
Annals of Arid Zone, Vol 21, No 1, p 25-28, March, 1982. 1 Tab, 8 Ref.

Descriptors: *Crop yield, *Water conservation, *Irrigation, *Mulches, Black polyethylene, Sawdust, Weed control, Soil moisture, Loam, Water supply, Water supply development, Arid zone, *India, Anand, *Antitranspirants, *Sunflower.

The effect of mulches and antitranspirants on the growth and yield of sunflower crop in rabi season was investigated. The soil was sandy loam with pH of 7.8, low in organic carbon, medium in phosphorus and high in potash content. Seed yield was significantly increased by one irrigation during the growth period during the year of 1975. Of our mulches tested, black polyethylene was significantly better than soil mulch in respect to yield; the latter was at par with wheat husk. Black polyethylene, wheat husk and soil mulch increased yield significantly more than sawdust during the year 1975-76. Use of the antitranspirants showed significantly higher seed yield for phenylmercuric acetate (PMS) as compared to kaolin. The antitranspirants help in conserving water and maintaining favorable water balances. The interaction between antitranspirants and irrigation showed that a significant response to irrigation was obtained when one irrigation was applied during the crop growth period and PAM was sprayed. Interactions between irrigation, antitranspirants and mulches indicated that one irrigation during the crop growth period of black polyethylene mulch and application of PMA yielded the highest seed yield. This may be due to better mositure status and weed control. (Baker-FRC)
W83-02001

A MODEL FOR THE OPTIMAL OPERATION OF AN IRRIGATION SYSTEM,
Demokritos Univ. of Thrace, Xanthi (Greece). School of Engineering.
G. Tsakiris, and E. Kiountouzis.
Agricultural Water Management, Vol 5, No 3, 1982. 3 Fig, 14 Ref.

Descriptors: *Irrigation efficiency, *Economic aspects, *Crop yield, Model studies, *Optimization, Sugar beets, Evapotranspiration, *Irrigation systems.

A procedure in the form of an inventory control model is described for deriving the optimal irrigation policy (depth and timing) which will minimize the total cost per unit time during each stage in the growing season of a single crop. After deriving the water depletion of the plant, the economic loss due to the decrease in yield caused by delaying irrigation and the cost of water application are considered. All variables are viewed as deterministic. An illustration of the method uses a semi-permanen' sprinkler irrigation system used on sugar beets in the third stage of growth (June-July). (Cassar-FRC)
W83-02019

RUNOFF AND SOIL LOSS FROM AN OXISOL IN SOUTHEASTERN NIGERIA UNDER VARIOUS MANAGEMENT PRACTICES,
Nigeria Univ., Nsukka. Dept. of Soil Science.
For primary bibliographic entry see Field 4D.
W83-02020

USING A CROP GROWTH SIMULATION MODEL FOR EVALUATING IRRIGATION PRACTICES,
Irrigation and Industrial Development Corp., New York.
S. S. Kundu, G. V. Skogerboe, and W. R. Walker.
Agricultural Water Management, Vol 5, No 3, p 253-268, 1982. 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Irrigation efficiency, *Growth stages, *Water use efficiency, *Corn, Soil moisture deficiency, Model studies, Crop yield, Evapotranspiration, California, Davis, Colorado, Grand Junction.

A crop growth simulation model (CORNGRO) was used to predict the effects of irrigation practices on crop yields, avoiding costly and time-consuming field experiments. Input data were plant characterization parameters, irrigation and daily climatic data, and soil characteristics. Its major parts are the moisture flow program and the plant growth program. The model was applied to: (1) determination of optimum soil moisture depletion and replenishment levels, and (2) timing and amount of irrigation during different crop growth stages. Data from two varieties of corn grown at Grand Junction, Colorado, and Davis, California, were used in the example. Results showed that maximum water use efficiency for Grand Junction was obtained if corn was irrigated when 40% of total available water was depleted; for the Davis site, 60% depletion. Yields were not appreciably affected by increasing the number of irrigations during one or more growth stages. The date and amount of last irrigation was more important if no irrigation was planned in the subsequent growth stage. (Cassar-FRC)
W83-02021

AN ANALYSIS OF TWO PRINCIPLE LEGAL/INSTITUTIONAL CONSTRAINTS TO AGRICULTURAL WATER CONSERVATION IN THE ELEVEN WESTERN STATES.
Teknekron Research, Inc., Berkeley, CA. Industrial Planning Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167817, Price codes: A07 in paper copy, A01 in microfiche. Report, November 1982. 145 p, 52 Tab, 1 Append. OWRT C-10057-C(1477)(1), 14-34-0001-1477.

Descriptors: *Water conservation, *Legal aspects, *Institutional constraints, *Agriculture, *Water rights, *Water transfer, Salvaged water, Irrigation water, Water banking, Costs, Attitudes, Diversion.

The legal/institutional structures most strongly impending water conservation are the prohibitions against temporary transfer of water rights and water banking, and the legal structures which make it difficult or impossible for an appropriator who salvages water to secure rights to that water. A survey was mailed to between 50 and 70 representative irrigation districts, canal companies and ditch companies in each of the eleven western states. Following the survey, a series of interiews was conducted with water users and water rights administrators throughout the west. Based on these studies, there is a definite correlation between irrigator perceptions of certain aspects of the state's legal structure and the level of conservation activities taken. The greater the perceptions that an appropriator may make short-term water transfers and that a salvager may retain a right to saved water, the more likely that a higher level of conservation activities has occurred. In states that reported a high level of short-term water transfers, there was also a high level of conservation activities and a high irrigator perception of a flexible legal struction. The principal reason why more water conservation activities have not occurred in the irrigation districts interviewed is that additional conservation activities would be too expensive. Irrigators most concerned about the diversion of agricultural water to energy interests were generally those with the least personal knowledge of specific transfers, those who overstated the quantities of water likely to be required by industry, and those who were unaware that most industry diversions are not transformed from irrigators. (Moore-SRC)
W83-02051

SURVEY OF THE WATER CONSERVATION PROGRAMS IN THE FIFTY STATES: MODEL WATER CONSERVATION PROGRAM FOR THE NATION,
Environmental Policy Inst., Washington, DC.
For primary bibliographic entry see Field 3D.
W83-02056

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FLOOD CONTROL FAILURE: SAN LORENZO RIVER, CALIFORNIA,
California Univ., Santa Cruz. Dept. of Earth Sciences.
G. B. Griggs, and L. Paris.
Environmental Management, Vol 6, No 5, p 407-419, September, 1982. 11 Fig, 4 Tab, 9 Ref.

Descriptors: *Flood control, *Planning, *Flood channels, Rivers, Channels, Engineering, Construction, San Lorenzo River, *California, Water management, Levees, Channel scour, Scour, Floods, Flood damage.

The San Lorenzo River on central California coast was the site of a major US Army Corps of Engineers flood control project in 1959. By excavating the channel below its natural grade and constructing levees, the capacity of the river was increased in order to contain approximately the 100 year flood. However, over the years the production and transport and transport of large volumes of sediment from the river's urbanizing watershed has filled the flood control project with sand and silt. The natural gradient has been reestablished, and flood protection has been reduced to that sufficient for containment of about the 30 year flood. Either an expensive annual dredging program must be started, or replanning and rebuilding of the inadequately designed flood control channel must be undertaken. It is concluded that large flood control projects provide a false sense of security and commonly produce unexpected channel changes. (Baker-FRC)
W83-01783

THE JONGLEI CANAL--NEEDED DEVELOPMENT OR POTENTIAL ECODISASTER.,
Khartoum Univ. (Sudan). Inst. of Environmental Studies.
For primary bibliographic entry see Field 6G.
W83-01785

NAVIGATION ON THE WESTERN RIVERS,
N. C. Venzke.
Transportation Research Record, Vol 825, p 15-17, 1981.

Descriptors: Water resources development, *Inland waterways, *Navigation, *Conferences, *Dredging, *Channel improvement, Evaluation, Water management, Transportation, Safety, Bridges, Locks, Dams.

The Second U. S. Coast Guard District is responsible for safe navigation on the western river system which extends into the industrial and agricultural heartland of the United States. The Second Coast Guard District marks the channels of the system and provides unlighted shore aids to navigation. The Coast Guard is working to improve communications between river interests and provide a viable feedback system. Eight regional (aids-to-navigation) conferences were set up, and the possibility of doubling cargo tonnage on the Upper Mississippi by the year 2000 was explored. The trend of over-dredging or over-depth dredging could become a threat to the safety of navigation. Under the Great I study, a 50-year channel maintenance plan would reduce the depth of the dredge and reduce channel widths in some areas. Reduced channel depths could seriously affect marine safety and may result in spills of hazardous cargoes. As channel depth is reduced, vessel fuel consumption is likely to increase. The Great II study identified bridges that produce high accident rates due to inadequate tow width to bridge openings. Corrective action is proceeding well on two of these bridges. Maintenance of the integrity of locks, dams, and bridges is of

vital importance to national transportaion needs. (Geiger-FRC)
W83-01831

FLOOD FREQUENCY ANALYSIS FOR REGULATED RIVERS,
For primary bibliographic entry see Field 2E.
W83-01833

COMPARISON OF EFFECTIVENESS OF MANAGEMENT OPTIONS FOR WETLAND LOSS IN THE COASTAL ZONE OF LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W83-01870

EFFECT OF HYDRILLA MANAGEMENT BY HERBICIDES ON A PERIPHYTON COMMUNITY,
Florida Univ., Gainesville. Center for Aquatic Sciences.
L. M. Hodgson, and C. C. Carter.
Journal of Aquatic Plant Management, Vol 20, p 17-19, January, 1982. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Aquatic weed control, *Herbicides, *Algae, Performance evaluation, Weed control, Aquatic weeds, Algal growth, Biomass, Primary productivity, Population dynamics, Chlorophyll a, Macrophytes, *Florida, Lake Pearl.

Exotic submergent aquatic weeds such as hydrilla (Hydrilla verticillata (L.f.) Caspary) present a significant economic problem and are particularly difficult to control. The effect of herbicide treatment of hydrilla on the associated periphyton community was investigated in Lake Pearl, located in Orange County, Florida. Chloriphyll a, cell numbers, and biovolumes were determined for the algae of the periphyton community associated with hydrilla infesting the lake following four different chemical treatments. Half of the lake was treated with chemicals on four occasions, while the other half of the lake served as a control area. Treatment with diquat and copper and with diquat and copper plus endothall resulted in increases in periphyton chlorophyll a and biovolume and reductions in hydrilla. A third treatment with diquat and copper and endothall and copper was less effective in reducing hydrilla, although it resulted in an increase in the periphyton community. The final treatment with diquat and copper controlled the hydrilla, but increases in periphyton communities were not significant. These results demonstrate an increase in periphyton communities following herbicide treatments to control hydrilla, suggesting that the removal of one component from the system may not have a signigicant effect on the total biomass of all primary producers in the system. (Carroll-FRC)
W83-01891

WATER RESOURCES AND GROWTH MANAGEMENT IN SOUTH FLORIDA,
Hole, Montes and Associates, Inc., Naples, FL.
For primary bibliographic entry see Field 6F.
W83-01895

MODEL FOR OPTIMAL SIZE AND LOCATION OF DETENTION,
Texas Univ. at Austin. Dept. of Civil Engineering.
L. W. Mays, and P. B. Bedient.
Journal of the Water Resources Planning and management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 270-285, October, 1982. 8 Fig, 2 Tab, 19 Ref.

Descriptors: *Detention reservoirs, *Urban watersheds, *Storm runoff, Storm water, *Model studies, *Optimization, Urban runoff, *Dynamic programming, Water storage, Water management, Surface water, Runoff, Water control, Watershed management.

A model is developed to determine the minimum cost, size and location of detention basins for urban watersheds. Based on dynamic programming, it can handle any arbitrary arrangement of detention basin locations and sizes. The concept of iso-drainage lines is used to introduce physical and design constraints into the model. Channel routing is done using a hydrograph time lag model. Detention basin routing is performed using a fourth-order Runge-Kutta solution of the continuity equation. This model considers many designs and selects the minimum cost solution for the specified physical and design limits. This is an improvement over conventional models, which can consider only a few alternatives. A sample problem using a hypothetical 10 sq mi rectangular watershed divided into 1 sq mi catchments is given. Its goal was to decrease the peak flow rates experienced after urbanization to the rates observed before development for a given rainfall frequency. A constraint was channel capacity. The solution for this probelm (5-100 year storms) was a total detention storage volume of 0.12 to 0.23 acre feet per acre and land requirements of 2.5-4%. For the 100 year storm three basins were chosen, 104.1, 77.7, and 76.2 acres, with the largest basin located farthest upstream. No detention storage was needed in the lower 1/3 of the watershed. (Cassar-FRC)
W83-01910

POINT-SLOPE APPROACH FOR RESERVOIR FLOOD ROUTING,
University of Southern California, Los Angeles. Dept. of Civil Engineering.
S. S. Butler.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1102-1113, October, 1982.

Descriptors: *Flood routing, *Hydrographs, *Reservoir operation, Point-slope method, Design storms, Design floods, Reservoir design.

A new point-slope method for routing floods resulting from statistically derived design storms is given as an alternative to traditional methods for routing floods through reservoirs. Instantaneous-time functions in the form of equations and criteria are used to determine the hydrograph slope at various points and the inflection point of the rising limb of the outflow hydrograph characteristics of the outflow structure. The check and adjustment procedure for improving routing solutions and the criteria for determining the inflection point may be used for traditional methods as well. Although the point-slope method is limited to simple single-peaked inflow hydrographs, it is fast, accurate, and adaptable for studying alternate reservoir and spillway designs. The point-slope method avoids the errors of the traditional methods (a degree of neglect of hydrograph curvature, carrying of arithmetic errors through several steps, and decisions in converting incremental step computations to smooth hydrographs). The error inherent in the point-slope method arises from drawing the outflow hydrograph through the trend of the point-slope lines. (Cassar-FRC)
W83-01927

DESIGN OF DUAL DRAINAGE SYSTEMS USING SWMM,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. H. Ellis, E. A. McBean, and G. Mulamoottil.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1222-1227, October, 1982. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Urban drainage, *Storm water, *Model studies, *SWMM model, *Ontario, Errors, Drainage, Runoff, Rainfall-runoff relationships, Hydrologic models.

This paper points out errors inherent in the traditional approach to modeling of dual drainage systems for urban areas using the Storm Water Management Model (SWMM) and suggests improvements in the procedure. Storm water drainage systems normally have dual components, minor (underground pipe system) and major (surface overland flow). The two-stage approach historically used in modeling produces erroneous responses because inputs from the two components do not reflect each other's presence. System flow is underpredicted, and pollutant maximum flux is overpredicted. To improve model performances, the input parameters for the major drainage system are adjusted, and the minor system is left untouched. A case study involving a 50 acre subdivision in Ontario illustrates the adjustment procedure. Good results were obtained after 6 model parameter iterations. (Cassar-FRC)
W83-01929

DISSIPATION OF 2,4-D RESIDUES IN LARGE RESERVOIRS,
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 5B.
W83-01932

CONTRIBUTION OF SNOWMELT TO THE OCTOBER 1978 FLOOD OF THE POMAHAKA AND FRASER RIVERS, OTAGO,
Otago Univ., Dunedin (New Zealand).
For primary bibliographic entry see Field 2C.
W83-01988

SOME RAINFALL FEATURES OF JULY 1979 STORM OVER LUNI BASIN,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2B.
W83-02002

A DESIGN-DISCHARGE CALCULATION METHOD BASED ON THE PARALLEL USE OF RESERVOIR MODELS,
Louvain Univ. (Belgium). Dept. of Agricultural Engineering.
G. Wyseure, J. Feyen, and J. Berlamont.
Agricultural Water Management, Vol 5, No 3, p 205-214, 1982. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Design floods, *Hydrologic models, *Hydrographs, Rainfall-runoff relationships, *Belgium, Model studies, Runoff, Groundwater movement, Drainage, Reservoir models, Urban runoff, Surface runoff, Simulation analysis.

Discharge peaks in complex catchments have several components: fast and slow groundwater drainage, surface runoff, and urban runoff. All components must be considered in calculating design discharge. To accomplish this, parallel reservoir models were used in three Belgian catchments: Bellebeek, which has undulating relief, loamy soils, and scattered urbanization; and Wamp and Grote Kaliebeek, both rural, flat, sandy watersheds. For Bellebeek the most suitable model was parallel use of cascades of linear reservoirs. Paved and unpaved areas were derived from cascades of two and three linear reservoirs, respectively. Discharge patterns in Wamp and Grote Kaliebeek were approximately simulated using a continuous parallel model of a single linear reservoir for fast groundwater drainage and one for slow groundwater release. The Kraijenhoff van de Leur resrvoir model was better adapted for simulating peak discharges for these two watersheds. Based on these investigations, models selected for design discharge calculations were the Kraijenhoff van de Leur for groundwater drainage and the cascade model of linear reservoirs for surface runoff. The hydrographs produced by this method provide more information for designing flood control works than a single maximum discharge value. (Cassar-FRC)
W83-02017

MANAGEMENT SCHEME FOR DEVILS LAKE BASIN WETLANDS,
North Dakota State Univ., Fargo.
R. D. Koob, and R. A. Ellison.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167809, Price codes: A12 in paper copy, A01 in microfiche.
North Dakota Water Resources Research Institute Report, March 1981. 263 p, 31 Fig, 39 Tab, 16 Ref. OWRT A-043-NDAK(4), 14-31-0001-5034.

Descriptors: *Wetlands, *Flood control, *Channel improvement, *Flood plain management, *Nonstructural alternatives, North Dakota, Planning.

Flood damage, Flood-control storage, Alternative planning.

The waters of the Devils Lake Basin (North Dakota) and other natural resources of the basin are threatened with deterioration which might endanger the natural stability and economic productivity of the basin. The principal water problem is damage to agricultural crops and land by sheet flooding; however, man's activities are a contributing factor to flooding. In spring, floodwaters overtop the banks of the low-capacity channels. Summer rains also produce streamflows in excess of channel capacities. An inventory and analysis of available data attempted to establish the scope and magnitude of the problems, and to identify cause and effect relationships of natural occurrences, practices and policies. With all of the information in hand from the inventory and anlysis phases, the alternate plan selection phase commenced. Essentially the alternatives were choices of levels of flood reduction, ranging from no action to nearly complete mitigation of flood damages. The Devils Lake Basin Plan which evolved from the selection process consists of a combination of policy statements, recommend studies and programs, and recommend structural and nonstructural measures. Structural measures include: 212 miles of channel improvements, 4 miles of new channel construction, 7 new lake control structures, the modification of one existing lake control structure, 9 grade stabilization structures, and 2 control structures on sloughs. Nonstructural measures include the use of natural water storage sites, land treatment, and the development of a flood plain management program. (Moore-SRC)
W83-02050

4B. Groundwater Management

HIGH PLAINS LOW ON WATER.
For primary bibliographic entry see Field 6D.
W83-01820

GROUNDWATER QUALITY MANAGEMENT,
Oklahoma Univ., Norman.
For primary bibliographic entry see Field 5G.
W83-02032

ASSESSMENT OF FRACTURE-TRACE MAPPING AS A GROUNDWATER PROSPECTING TOOL IN THE METAMORPHIC TERRANE SURROUNDING FAIRBANKS, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
R. F. Carlson, D. B. Hawkins, and C. I. Hok.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167908. Completion Report 80-12, October, 1981. 15 p, 17 Ref, 1 Append. OWRT A-067-ALAS(1), 14-34-001-1102.

Descriptors: *Groundwater, *Alaska, Geology, *Fracture-trace, Sedimentary structures, Metamorphic structures, Joints, Metamorphic rocks, *Photogeology, *Geologic mapping, *Groundwater availability, Fairbanks area.

The development of adequate and reliable groundwater supplies is a persistent problem throughout Alaska, especially in metamorphis and igneous terranes where substantial residential development is taking place. The problem is especially acute in the highland terranes surrounding the two largest metropolitan areas of Alaska, Anchorage and Fairbanks. This project assessed the usefulness of both fracture-trace and lineament mapping for groundwater prospecting in terranes typical to Alaska. If proved useful, this tool will greatly enhance water well location and offer large potential savings to the public. It appears that the terranes in the Fairbanks area will be difficult to analyze, since much of the surrounding hills are covered with windblown silt. However, the higher terranes of the Anchorage and Kodiak areas appear to be ideally suited for analysis with the fracture-trace technique. We hope to continue the work in the Fairbanks area and expand it to the Anchorage area with a grant from the State of Alaska.
W83-02060

MANAGING OUR LIMITED WATER RESOURCES: THE OGALLALA AQUIFER.
Civil Engineering (New York), Vol 52, No 10, p 14, 17, October, 1982. 1 Fig.

Descriptors: *Water management, *Water supply development, *Aquifers, Groundwater, High Plains, United States, Water resources development, *Ogallala aquifer, Irrigation, Water demand.

The Ogallala aquifer spreads under some 20 million acres in Nebraska through Kansas, Colorado, New Mexico and Oklahoma to Texas. Over 150,000 wells have been tapped into this aquifer. Many fear that water is being drawn off at such a rate as to jeopardize High Plains irrigation - leading to severe food shortages. A study is underway which will produce a report in about a year, including the following topics: a subjective appraisal of water management functions and issues, a look at methods as reflected by the principles and standards, and a look at procedures for integrating structural and non-structural methods and integrating quantity and quality issues; a discussion of topics which define water availability, permit requirements and other regulatory considerations; a discussion of cost allocation and cost sharing; and the allocation of water management responsibilities among the several levels of government in the federal system. (Baker-FRC)
W83-02075

4C. Effects On Water Of Man's Non-Water Activities

PREDICTION OF STORM-INDUCED SEDIMENT YIELD FROM HIGHWAY CONSTRUCTION,
L. M. Younkin, and G. B. Connelly.
Transportation Research Record, Vol 832, p 1-6, 1981. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Prediction, *Mathematical models, *Soil erosion, *Sediment yield, *Storm runoff, *Highway effects, *Road construction, Model studies, Erosion, Sediment transport, Stream erosion, Mathematical equations, Environmental effects.

A mathematical model was developed for predicting storm-induced increases in suspended sediment yield in a stream system due to highway construction. A prediction equation was formulated by regression analysis of data collected at nine streamgage sites in five watersheds in Pennsylvania. The analysis emcompassed 278 data sets. The model relates factors describing soil erodibility, rainfall, construction phases and proximity to the construction site to the increased quantity of sediment transported. Results show that the amount of sediment transported increases with soil erodibility, storm-erosion index, area cleared and grubbed, cut-and-fell heights, and proximity of construction to the stream. The standard error of the final form of the equation was large, although not exceptional when compared with the results of other sediment-transport studies. The equation may be used as a tool in highway location studies, evaluation of highway development impact, and design of sediment catchment devices. (Geiger-FRC)
W83-01832

4D. Watershed Protection

EROSION CONTROL AT CONSTRUCTION SITES ON RED CLAY SOILS,
Wake Forest Univ., Winston-Salem, NC. Dept. of Biology.
A. D. Lemly.
Environmental Management, Vol 6, No 4, p 343-352, July, 1982. 4 Fig, 5 Tab, 52 Ref.

Descriptors: *Erosion control,. *Construction. *Sedimentation, *Clays, Runoff, Urban runoff, Mulches, Denudation, *North Carolina, Red clay soils, Soil erosion, Sediments.

Five single treatments and a multiple treatment for stabilizing soil at urban and highway construction sites were compared using experimental plots of North Carolina red clay soil and natural rainfall episodes from April to June 1981. Plot slopes were 10-50%. The most effective erosion control method was the multiple treatment (chemical soil binder, fiberglass erosion check at the slope base, and asphalt-tacked straw overlain with staple-tacked jute netting). Single treatments consisted of asphalt-tacked straw, jute netting, mulch blanket, wood chips, and staple-tacked excelsior blanket. Reductions in total mean sediment were (with the smaller values representing 50% slope and the large values, 10% slope): tacked straw, 23-42%; jute netting, 30-55%; mulch blanket, 52-76%; wood chips, 51-78%; excelsior blanket, 52-78%; and multiple treatment, about 90%. The percent reduction of coarse particles ($<$ 0.04 mm diameter) in the eroded material varied from $>$ 96% at 10% slope to 70-82% at 50% slope. The percent reduction of fine particles ($<$0.04 mm diameter) varied from 2-4% at 10% slope to 18-30% at 50% slope. Although grass cover exceeded 90% on all plots after 60 days, sediment yield was not decreased on tacked straw and jute netting because of poor rooting and piping. These results indicate the importance of considering the fine sediment component, most damaging to aquatic life. Although total sediment load may be reduced by 75%, considerable fine material may be put into receiving waters, especially at the higher slopes seen in highway cuts. Although the multiple treatment approach is clearly superior to single treatments in controlling erosion on these soils, the extra cost is a deterring factor. (Cassar-FRC)
W83-01774

BIOTECHNICAL BANK STABILIZATION,
Newark Dept. of Public Works, DE.
A. W. Fridl, and M. W. Demetrious.
Public Works, Vol 113, No 10, p 62-63, October, 1982. 2 Fig.

Descriptors: *Bank stabilization, *Gabions, *Erosion control, Biotechnical bank stabilization, Christiana Creek, Newark, *Delaware, Channel erosion, Stream stabilization, Willows, Bank erosion, Bank protection.

Banks of the Christiana Creek at Newark, Delaware, were stabilized by a biotechnical method, which combined stone, timbers, and vegetation. The plan called for two 100 ft long, 8 ft high gabions, a 110 ft long timber crib-gabion mat combination, 4 gabion deflectors, and 135 willow shoots planted in and around the structures and on the banks. No dredging, widening, or significant changes were made in the existing hydraulic features of the channel cross section. Deflectors were placed where the creek turned 90 degrees and was eroding the outer bank. Ten months after installation the deflectors were providing the desired effect, buildup along the east bank and cutting on the west bank. Total cost for the project was $50,000. (Cassar-FRC)
W83-01810

MODEL STUDY OF LOW DROP GRADE CONTROL STRUCTURES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 8B.
W83-01888

ENVIRONMENTAL EFFECTS OF A MEDIUM-FERTILITY 12-MONTH PASTURE PROGRAM: I. HYDROLOGY AND SOIL LOSS,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5G.
W83-01973

PREDICTION OF PHOSPHORUS LOSSES IN RUNOFF FROM SOUTHERN PLAINS WATERSHEDS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W83-01979

RUNOFF AND SOIL LOSS FROM AN OXISOL IN SOUTHEASTERN NIGERIA UNDER VARIOUS MANAGEMENT PRACTICES,
Nigeria Univ., Nsukka. Dept. of Soil Science.
M. E. Obi.
Agricultural Water Management, Vol 5, No 3, p 193-203, 1982. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Infiltration, *Surface sealing, *Vegetation effects, Runoff, Oxisol, *Nigeria, Soil surfaces, Erosion control, Soil erosion, Soil conservation, Sediment yield, Soil management, Agricultural runoff.

Infiltration, runoff, and soil loss were studied on oxisol with 5% slope on an experimental farm in Nigeria using six management practices: (1) bare fallow, (2) maize on flat cultivated soil, mulched, across the slope, (3) maize on flat cultivated soil, unmulched, across the slope, (4) sweet potatoes, (5) legume, and (6) grass. Infiltration rates (mm per hour) after 3 hours were: bare fallow, 235; maize with no mulch, 400; grass, 650; legume, 750; and mulched maize, 947. During the first hour infiltration on grass plots reached over 1800 mm per hour. No runoff or soil loss occurred on legume, grass, and sweet potato plots. During the 2 years of study, 1979 and 1980, bare fallow had the highest runoff and soil loss, 177-204 mm and 5.5-3.5 kg per sq m, respectively. Unmulched maize runoff and soil losses were intermediate; mulched maize results were 12-17 mm and 0.1-0.2 kg per sq m. The major cause of poor infiltration in this soil was surface crusting. (Cassar-FRC)
W83-02020

DEVELOPMENT AND APPLICATION OF MODELS FOR ANALYZING WATER RESOURCE USE AND DEVELOPMENT WITHIN A REGIONAL FRAMEWORK OF ECONOMIC GROWTH AND ENVIRONMENTAL QUALITY,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 5G.
W83-02063

PROTECTIVE SOIL STABILIZATION FOR RIVER SLOPES,
R. Boyes.
Civil Engineering (London), p 19, 21, 23, 25, September, 1982. 5 Fig, 13 Ref.

Descriptors: *Slopes, *Erosion control, *Vegetation, Chemicals, Rivers, River slopes, Runoff, Rainfall, Erosion, Flood control.

Vegetation consisting of grasses and woody plants has two roles to play for embankment slope stabilization. First, it acts as a mechanical stabilizing force to buttress up and create arching in the soil, with the deeper penetrating trees and shrub roots acting as tension and compression reinforcement elements. The second role is to provide resistance to wind, rainfall and flood erosion. Here the soil slope surface is protected against both down-slope wash movement and the resulting down-river transport of loosened sediment. This is more the role of grasses. Chemical stabilization of slopes is best employed in forming temporary slope protection on sandy soils down to about SP-SM in general classification above the waterline. The two best chemical treatments appear to be water soluble urethane at seven percent dry material concentration and a cationic asphalt emulsion at 50% dry material concentration. However, both are costly. (Baker-FRC)
W83-02074

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MICROORGANISMS AS INDICATORS OF TOXICITY OF NATURAL AND WASTE WATERS,
Gorkii State Univ. (USSR). Inst. of Chemistry.
A. A. Tumanov, I. E. Postnov, N. I. Osipova, and I. A. Filimonova.
Hydrobiological Journal, Vol 17, No 5, p 71-74, 1981, 26 Ref.

Descriptors: *Pollutant identification, *Bioindicators, *Biological magnification, Wastewater treatment, *Microorganisms, *Heavy metals, *Trace elements, *Water quality control, Assay, Bioassay, Reviews, Indicators, Bacteria, Water analysis, Toxicity, Molds, Yeasts, Fungi, Monitoring, Trace metals.

The high sensitivity of microorganisms to metal ions, organic and organometallic compounds makes them useful indicators of small amounts of such pollutants in natural waters and wastewater. There is much controversy over whether more highly organized animals such as Daphnia are better indicators of pollution than the lower forms such as bacteria, Protozoa and algae. Some biotesting methods based on biochemical or physiological responses of microorganisms cannot always be used because of their complexity. The simplest biotests are often those based on changes in growth rates of microorganisms in a given chemical environment. Certain molds, yeasts and bacteria grow well on nutrient media and can be used as analytical indicators. The diffusion method may be used for determining the presence of phenol and petroleum products in wastewater with the aid of bacteria and yeasts. Automatic devices which continuously grow microorganisms are used for monitoring the toxicity of industrial effluents. Some bioactive agents can stimulate the growth of living organisms. The method of element determination which is based on stimulation effects can be used to detect the presence of trace elements in water. Biological concentration by organisms can be used as a process whereby rare and scattered elements could be extracted or as a method of purifying and analyzing wastewater. If solutions contain small amounts of toxic substances which cannot be directly detected, then chemical and biological methods of concentration need to be combined. In biological testing, other impurities in the water generally do not interfere with the analysis thus eliminating the need for sample preparation. (Geiger-FRC)
W83-01753

ION CHROMATOGRAPHIC DETERMINATION OF ANIONS IN RAINWATER,
Niigata Coll. of Pharmacy (Japan).
K. Oikawa, and H. Saito.
Chemosphere, Vol 11, No 9, p 933-941, September 1982, 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Anions, *Ion exchange, *Acid rain, Pollutant identification, *Chromatography, *Ion chromatography, Fluorides, Chlorides, Bromides, Nitrites, Nitrates, Sulfites, Sulfates, Phosphates.

Ion chromatography (IC) was used for rapid analysis of rainwater for common anions associated with acidity (fluoride, bromide, nitrate, sulfite, sulfate, phosphate, and nitrite) using the standard method. The procedure used a Bionex Corp. Model 14 chromatograph. The sample was filtered with a membrane filter before injection into the apparatus. The 3 x 500 mm separator column contained low-capacity anion exchange resin; the 6 x 250 mm suppressor column, high capacity cation exchange resin. The eluant, 2 nM NaC03/5 nM NaOH, produced good results, except for nitrite determination. By using a standard solution or sample solution with the same characteristics as the eluant, nitrite results were improved. Coefficients of variation were $< 10\%$ for all anions. When the detection limit was twice the signal to noise ratio of the baseline, the detection limits (ppm) were: fluoride, 0.01; chloride, 0.02; nitrite, 0.05; nitrate, 0.1, sulfite, 0.5; and sulfate, 0.1. Analysis of rainwater samples collected over a period of 15 min showed the highest ion concentrations at the beginning of the storm (11.4 ppm C1, 5 ppm sulfate, 2.5 ppm nitrate, and 1.75 ppm sulfite), decreasing to < 1 ppm each at about 4 min. IC was also successfully applied to trace analysis of raindrops collected by aircraft. (Cassar-FRC)
W83-01756

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF PYRIDAZINONES IN WASTE WATERS. II.
Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia). Chemickotechnologiska Fakulta.
J. Lehotay, E. Matisova, J. Garaj, and A. Violova.
Journal of Chromatography, Vol 246, No 2, p 323-326, 1982, 3 Fig, 1 Tab, 5 Ref.

Descriptors: *High performance liquid chromatography, *Pollutant identification, *Wastewater analysis, *Organic compounds, Separation techniques, Organic wastes, *Chromatography, *Gas chromatography, Chemical analysis, *Pyridazinones.

A high performance liquid chromatography method for the determination of pyridazinones in wastewaters was developed. The new method is applicable to very small amounts of sample and may be performed at a speed compatible with routine measurement requirements and reliability. Solvent extraction was performed on a MicroPak CN column using different mobile phases for PCA (5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone) and PCC (4,5-dichloro-2-phenyl-3(2H)-pyridazinone). Recovery experiments were performed using standard solutions of PCA and PCC. Results were evaluated by linear least-squares fitting of the curves of amounts of PCA or PCC injected against peak area. The resulting shapes of the peaks of PCA and PCC were symmetrical. The limits of detection of injected standards were found to be 40 nanograms of PCC and 50 nanograms of PCA in 10 microliters of solution. Levels of PCA in wastewaters ranged from 0.82 to 1.43 milligrams/liter and levels of PCC ranged from 4.02 to 4.21 milligrams/liter. These results suggest that the present method is potentially useful for the detection of trace amounts of PCA and PCC in wastewaters. (Geiger-FRC)
W83-01760

DETERMINATION OF POLAR ORGANIC SOLUTES IN OIL-SHALE RETORT WATER,
Geological Survey, Denver, CO.
J. A. Leenheer, T. I. Noyes, and H. A. Stuber.
Environmental Science and Technology, Vol 16, No 10, p 714-723, October 1982, 2 Fig, 3 Tab, 28 Ref.

Descriptors: *Oil shale, *Organic compounds, *Industrial wastewater, Wastewater analysis, *Pollutant identification, *Dissolved organic carbon, *Gas-condensate retort water, *Polar organic solutes.

Polar organic solutes were quantitatively determined by a variety of analytical methods in process retort water and a gas-condensate retort water produced in a modified in situ oil shale retort. In the process retort water organic compounds consisted largely of nonvolatile organic anions and polyfunctional neutral compounds. The gas-condensate water contained mainly steam-volatile polar compounds. About 50% of the dissolved organic carbon was identified in both waters. Retort water dissolved organic carbon was identified in both waters. Retort water dissolved organic carbon (3000 mg per liter) was 42% fatty acids from C2 to C10, 1.4% aliphatic dicarboxylic acids, 2.2% phenols, 1.1% hydroxypyridines, and 1.2% aliphatic amides. Gas-condensate water dissolved organic carbon (790 mg per liter) was composed of 19.3% aromatic amines, 17.8% phenols, 4.3% nitriles, 3.5% aliphatic alcohols, 2.4% aliphatic ketones, and 1.3% lactones. (Cassar-FRC)
W83-01763

DETERMINATION OF EFFLUENT TOXICITY FROM STATE OF PIGMENTED CELLS AND NEURAL APPARATUS OF FISH SKIN,
Volgograd State Medical Inst. (USSR).
A. L. Burkovskiy, and S. G. Kul'kin.
Hydrobiological Journal, Vol 16, No 5, p 96-99, 1981. 5 Fig, 6 Ref.

Descriptors: *Pollutant identification, *Bioindicators, *Carp, *Perch, *Fish physiology, Toxicity, Indicators, Bioassay, Fish, Water pollution effects, Wastewater pollution, Pigments.

A simple method was developed for determining the toxicity of sewage using the melanocytes and nerve fibers linked to various components of fish skin, including the pigmented cells. After exposure, carp and perch fry and yearlings were fixed in neutral formalin. Scales were removed, and skin samples were examined under a microscopic in transmitted light without staining. Cytoplasmic stains were used to define and describe the configuration of the processes and perikaryon of the pigmented cell. Early damage of the melanocytes upon intoxication is marked by swelling of cytoplasmic processes. In the next stage of intoxication, the melanin granules are transported to the perikaryon. In the next stage of destruction of the melanocytes, the pigmented cells are contracted and degraded. The number and configuration of such affected melanocytes can be statistically evaluated. In the final stage of melanocyte degradation, the innervating apparatus degenerates. The present method can be used under laboratory or field conditions. (Geiger-FRC)
W83-01765

MUTAGENIC ACTIVITY OF ORGANIC MATTER IN AN URBAN RIVER SEDIMENT,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5C.
W83-01781

A COMPARISON OF CHEMICAL LOAD ESTIMATION ALGORITHMS USING DATA OBTAINED BY SAMPLING FOUR SOUTH AFRICAN RIVERS AT VARYING FREQUENCIES,
Hydrological Research Inst., Pretoria (South Africa).
D. C. Grobler, C. A. Bruwer, P. J. Kemp, and G. C. Hall.
Water SA, Vol 8, No 3, p 121-129, July, 1982. 8 Fig, 2 Tab.

Descriptors: *Pollution load, *Sampling, Rivers, Water quality, *Algorithms, *South Africa, Nitrates, Phosphates, Dissolved solids, Chlorides, Suspended solids, Pollutant identification, Vaal River, Balfour River, Blinkwater River, Orange River.

Six algorithms for calculating constituent loads from continuous flow records and discrete constituent concentration records were compared using data from four rivers in South Africa. No one algorithm was superior in all cases. The best algorithm had to be selected by considering both the type of constituent (conservative, nonconservative or suspended solids) and the sampling frequency. Generally, the load estimation algorithms overestimated conservative constituents (total dissolved solids and chlorides) loads, underestimated suspended solids loads, slightly overestimated nitrate loads and slightly underestimated phosphate loads. When sampling frequency was reduced in the dry season, accuracy of load estimations was not adversely affected. (Cassar-FRC)
W83-01825

EVALUATION OF INCREASES IN DISSOLVED SOLIDS IN GROUND WATER, STOVEPIPE WELLS HOTEL, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
A. Buono, and E. M. Packard.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.75 per paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-513, July 1982. 19 p, 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Groundwater, *Dissolved solids, *Water supply, *Water quality, Path of pollutants, Observation wells, Montoring, Well data, Potable water, Water yield, Water level, Groundwater movement, Reverse osmosis, Mesquite, Data collections, *California, Death Valley National Monument, Stovepipe Wells Hotel.

Increases in dissolved solids have been monitored in two observation wells near Stovepipe Wells Hotel, Death Valley National Monument, California. One of the hotel's supply wells delivers water to a reverse-osmosis treatment plant that produces the area's potable water supply. Should water with increased dissolved solids reach the supply well, the costs of production of potable water will increase. The reverse-osmosis plant supply well is located about 0.4 mile south of one of the wells where increases have been monitored, and 0.8 mile southwest of the well where the most significant increases have been monitored. The direction of local ground-water movement is eastward, which reduces the probability of the supply well being affected. Honey mesquite, a phreatophyte located about 1.5 miles downgradient from the well where the most significant increases have been monitored, might be adversely affected should water with increased dissolved solids extend that far. Available data and data collected during this investigation do not indicate the source of the dissolved-solids increases. Continued ground-water-quality monitoring of existing wells and the installation of additional wells for water-quality monitoring would be necessary before the area affected by the increases, and the source and direction of movement of the water with increased dissolved solids, can be determined. (USGS)
W83-01858

A RAPID, DIRECT HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC METHOD FOR THE SIMULTANEOUS QUANTITATIVE DETERMINATION OF CARBARYL AND ALPHA-NAPHTHOL IN AQUEOUS SAMPLES,
Southeastern Forest Experiment Station, Research Triangle Park, NC. Forestry Sciences Lab.
A. S. Jones, L. A. Jones, and F. L. Hastings.
Journal of Agricultural and Food Chemistry, Vol 30, No 5, p 997-999, September/October, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water analysis, *Carbaryl, *Organic compounds, Naphthol, *Chromatography, *Pollutant identification, Analytical methods.

A rapid, quantitative HPLC enrichment/analysis procedure was developed for carbaryl (I) and alpha-naphthol(II) in the ppb range in well water. A 2-mL volume of aqueous sample, contained in the sample loop of a Waters Associates U6K injector, is flushed onto the head of a 4.0 mm x 30 cm microBondapak C18 column, where the solutes are adsorbed and concentrated. Elution with a 60:40 methanol-water mobile phase at a flow rate of 1.0 mL/min provided good separation of carbaryl and alpha-naphthol from each other and from all unidentified UV-absorbing compounds present in the water. The utility of Sep-PAK C18 cartridges for storing field-collected aqueous carbaryl samples was demonstrated. Samples can be stored on the cartridges at ambient temperature for 5 days, with subsequent recoveries of 98% and 89% for carbaryl and alpha-naphthol, respectively. (Baker-FRC)
W83-01892

DISTRIBUTION OF TOXIC SUBSTANCES IN RIVERS,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-01902

DETERMINATION OF ABATE IN ENVIRONMENTAL WATER SAMPLES BY DENSITOMETRY ON PREADSORBENT REVERSED-PHASE THIN-LAYER PLATES,
Lafayette Coll., Easton, PA. Dept. of Chemistry.
J. Sherma, and J. L. Boymel.
Journal of Chromatography, Vol 247, No 1, p 201-204, September, 1982. 2 Fig, 9 Ref.

Descriptors: *Pollutant identification, *Thin layer chromatography, *Separation techniques, *Organophosphorus pesticides, Chromatography, Pesticides, Insecticides, Larvicides, Water analysis, Natural waters, *Abate.

The organophosphorus insecticide, Abate (temephos) was determined in water samples by a quantitative thin layer chromatographic method on reversed phase chemically bonded C18 plates with a preadsorbent spotting area. Detection is performed with the selective and sensitive reagent for organophosphorus pesticides, N,2,6-trichlorobenzoquinoneimine (TCQ). Using this procedure, recovery for distilled water averaged 96.0% for four trials, while recovery from fortified blank pond and river waters averaged 88.1% and 83.7%, respectively, for four trials. The combined selectivity of the TLC separation and the detection reagent allowed the natural water samples to be analyzed without cleanup. The present TLC method is able to analyze multiple samples simultaneously under identical conditions and to process standards in parallel. The method is able to analyze residues at low parts per million levels in water with speed, accuracy and precision and may be applied to other sample matrices if certain cleanup steps are carried out. (Geiger-FRC)
W83-01983

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC SEPARATION AND SELECTIVE DETECTION OF ANIONIC SURFACTANTS. APPLICATION TO COMMERCIAL FORMULATIONS AND WATER SAMPLES,
Amsterdam Univ. (Netherlands). Lab. for Analytical Chemistry.
F. Smedes, J. C. Kraak, C. F. Werkhoven-Goewie, U. A. T. Brinkman, and R. W. Frei.
Journal of Chromatography, Vol 247, No 1, p 123-132, September, 1982. 10 Fig, 18 Ref.

Descriptors: *Pollutant identification, High performance liquid chromatography, *Separation techniques, *Surfactants, *Fluorometry, Water analysis, Sulfonates, Sulfates, *Chromatography, Biodegradation.

Reversed-phase liquid chromatography coupled with post-column ion-pair extraction detection was used to analyze C10-C18 homologues of sulfonate and sulfate type surfactants using Hypersil SAS and ODS packings and water-acetone mixtures as the mobile phase. An acetone gradient was applied for the separation of more than five successive homologues. Anionic surfactants were detected as ion pairs in mixtures of effluent plus chloroform and acridinium chloride solution. The ion pairs were extracted into the chloroform phase and monitored fluorimetrically. The system behaved linearly for up to 4 micrograms of anionic surfactant injected. The detection limit ranged from 1 to 5 nanograms, regardless of the length of the alkyl chain of the solutes. The method has been found suitable for the analysis of commercial surfactant formulations and the detection of anionic surfactants at parts per billion levels in water samples after preconcentration on a small reversed-phase column. The latter application may be useful in the following the biodegradability of anionic surfactants. (Geiger-FRC)
W83-01984

DETERMINATION OF VOLATILE HALOCARBONS IN RAW AND DRINKING WATER, HUMAN SERUM, AND URINE BY ELECTRON CAPTURE GC,
Abo Akademi, Turku (Finland). Inst. of Wood Chemistry and Pulp and Paper Technology.
M. Reunanen, and R. Kroneld.
Journal of Chromatographic Science, Vol 20, No 10, p 449-454, October, 1982. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Potable water, *Water analysis, *Gas chromatography, Fresh water, Natural waters, Lakes, Streams, *Organic compounds, *Hydrocarbons, *Pollutant identification, *Halocarbons.

A method for quantitative determination of volatile halocarbons in raw and drinking water, human serum, and urine is presented. Samples of water were extracted in a single step with petroleum ether, and the extracts without further purification were analyzed by high resolution gas chromatography with electron capture detection. Both external and internal calibrations were used to standardize the analytical system. External calibration is done with pure halocarbons in purified well water. Internal calibration is accomplished by spiking serum and urine samples with reference halocar-

bons between each of two successive extractions and GC run. 1-Iodobutane was the internal standard used in both calibrations and actual determinations. (Baker-FRC)
W83-01985

DETERMINATION OF TRACE BERYLLIUM BY GC,
Institute of Nuclear Energy Research, Lung-Tan (Taiwan). Analytical Chemistry Center.
C-J. Kuo, I-H. Lin, J-S. Shih, and Y-C. Yeh.
Journal of Chromatographic Science, Vol 20, No 10, p 455-460, October, 1982. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Gas chromatography, *Beryllium, *Uranium oxide, Drinking water, Water quality, *Pollutant identification.

Trace beryllium in uranium oxide and tap water was determined by electron-capture detection. After dissolving, samples were mixed with an ethanol solution of 0.08 N trifluoroacetylacetone to form a single phase system. The Be(TFA)2 complex that formed was extracted to cyclohexane. The excess of free HTFA in cyclohexane was washed with 0.1 M NaHC03 solution; the effects of organic extractants (solvents), pH value, and shaking time on recovery are also discussed. The detection limit with this method was 2 x 10 to the minus 11th power g of Be. The content of Be in tap water could be determined as low as the sub-ppb order. It was also demonstrated that the fluoride ion interfered with the determination of Be. (Baker-FRC)
W83-01986

IMPROVED MICROAUTORADIOGRAPHIC METHOD TO DETERMINE INDIVIDUAL MICROORGANISMS ACTIVE IN SUBSTRATE UPTAKE IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
P. S. Tabor, and R. A. Neihof.
Applied and Environmental Microbiology, Vol 44, No 4, p 945-953, October, 1982. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Microorganisms, Natural waters, *Radioactivity techniques, *Uptake, *Fluorescence, *Microscopic analysis, *Substrates, Tritium, Aquatic populations, Metabolism, Microbiological studies, Chesapeake Bay, Pollutant identification.

A new method is described which combines epifluorescence microscopy and microautoradiography to determine the total number of microorganisms in natural water populations and those individual organisms active in the uptake of specific substrates. After incubation with tritium-labeled substrate, the sample is filtered and mounted directly in a film of autoradiographic emulsion on a microscope slide while still on the filter. The micro-autoradiogram is processed and stained with acridine orange and the filter is removed before microscopic observation. This procedure gave increased accuracy in direct counts made from the autoradiogram and provided improved sensitivity in the recognition of uptake-active radioactive-labeled organisms. The present method also resulted in the enumeration of a significantly greater number of labeled organisms compared with corresponding samples prepared by a previously reported technique. (Geiger-FRC)
W83-01993

SELECTED NUCLEIC ACID PRECURSORS IN STUDIES OF AQUATIC MICOBIAL ECOLOGY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W83-01994

THE SEPARATION OF TUNGSTATE AND MOLYBDATE BY ION CHROMATOGRAPHY AND ITS APPLICATION TO NATURAL WATERS,
Geological Survey, Denver, CO.
W. H. Ficklin.
Analytical Letters, Vol 15, No 109, p 865-871, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Water analysis, *Ion chromatography, Chemical analysis, Tungsten, Molybdenum, Surface waters, Natural streams, Lakes, Rivers, *Tungstate, *Molydate, *Pollutant identification, Separation techniques.

Ion chromatographic separation of tungstate and molybdate was achieved using a 3 x 250 mm standard anion separator column, a 0.006 M sodium carbonate eluent, a standard anion suppressor column, and a flow rate of 90 ml/hr. Elution of peaks for the species tungstate nd molybdate occurs at 9 and 12 minutes, respectively, and peak heights are distinguishable from the baseline at concentrations of 0.1 mg/liter, using a full scale deflection of 10 micromho and a dual-pen recorder. Tungstate and molybdate must be concentrated from 1 liter of water by collecting them on a chelating resin after the pH of the water was adjusted to between 1 and 2. Tungstate and molybdate were eluted with concentrated ammonium hydroxide. The ammonia was evaporated, leaving a water solution containing tungstate and molybdate. About 90% of the tungsten and molybdenum was recovered, with a relative standard deviation of about 15% at the microgram/liter level. Natural concentrations of tungsten or molybdenum as small as 1 microgram/liter are measured by this technique. (Baker-FRC)
W83-02003

MICROSAMPLE-FILTERING DEVICE FOR LIQUID CHROMATOGRAPHY OF FLOW INJECTION ANALYSIS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, and H. A. Vanderploeg.
Analytical Chemistry, Vol 54, No 12, p 2129-2130, October, 1982. 2 Fig, 8 Ref.

Descriptors: *Water analysis, *Flow injection, *Filters, Liquid chromatography, *Chromatography, Sampling, Sample preparation, *Pollutant identification.

An efficient technique was developed to remove particles from relatively small samples but still recover sufficient filtrate for analysis. The technique uses a microsample-filtering assembly, interfaced directly with the loop injector of a previously described ammonium analyzer. The device allows the analyst to rinse the filter, filter the sample and load the injection loop with a single sample-handling step. It provides a convenient, desirable method to clean up samples prior to HPLC or flow-injection analysis. The device as described was designed for low-pressure sliding injection valves, but could be used with appropriate adaptors on other loop-injection systems. (Baker-FRC)
W83-02004

INTERFERENCES IN AUTOMATED PHENOL RED METHOD FOR DETERMINATION OF BROMIDE IN WATER,
Kansas Univ., Lawrence. Dept. of Chemistry.
C. L. Basel, J. D. Defreese, and D. O. Whittemore.
Analytical Chemistry, Vol 54, No 12, p 2090-2094, October, 1982. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Bromide, *Water analysis, *Pollutant identification, *Phenol red method, *Chloride, Ammonium, Bicarbonates, Chemical reactions.

The automation of the phenol red method for the determination of bromide in natural waters is described. Use of segmented flow analysis allows analysis of samples at a rate of 20 samples/hr with a method detection limit, defined as the concentration giving a signal about three times the standard deviation of replicate analyte determinations in reagent water, of 10 micrograms/liter. Samples studies include oil-field brines, halite solution brines, groundwaters. Chloride and bicarbonate cause significant positive interferences at levels as low as 100/liter and 50 mg/liter, respectively. Ammonia gives a negative interference that is important at levels as low as 0.05 mg/liter. An ionic strength buffer is used to suppress a positive ionic strength interference, correction curves are used to compensate for the chloride interference, the bicarbonate interference is minimized by acidification, and the ammonia interference is eliminated by its removal by ion exchange. Reaction product studies are used to suggest a plausible mode of chloride interference. (Baker-FRC)
W83-02005

DETERMINATION OF PHOSPHORUS AT THE PARTS PER TRILLION LEVEL BY LASER-INDUCED THERMAL LENSING COLORIMETRY,
Tokyo Univ. (Japan). Dept. of Physics.
For primary bibliographic entry see Field 2K.
W83-02006

CONTINUOUS FLOTATION OF TRACE AMOUNTS OF NITRITE ION IN WATER,
Tokyo Metropolitan Univ. (Japan). Dept. of Industrial Chemistry.
For primary bibliographic entry see Field 2K.
W83-02007

MICROSCALE FUNCTIONAL GROUP ANALYSIS OF MARINE AND SEDIMENTARY HUMIC SUBSTANCES,
Liverpool Univ. (England). Dept. of Oceanography.
A. H. Gillam, and J. P. Riley.
Analytica Chimica Acta, Vol 141, p 287-299, 1982. 3 Fig, 2 Tab, 29 Ref.

Descriptors: *Humic acids, *Sediments, Chemical analysis, Acidity, Carboxylic acids, *Phenols, *Quinones, *Hydroxamates, Water analysis, *Dissolved organic matter, *Pollutant identification.

Methods are described for the microscale analysis of aquatic and sedimentary humic substances for several oxygen-containing functional groups including total acidity, carboxylic and phenolic hydroxyl groups, quinone groups and hydroxamate linkages. Coefficients of variation of the methods ranged from 4.9 to 12.9%. Elemental analyses of the freshwater and sedimentary humic substances of this study indicate that between 34 and 88% of the oxygen in the aquatic humic substances studied is present in the carboxylic and phenolic hydroxyl groups. For the sedimentary humic substances the range was 18-42%. This clearly shows the dominance of the acidic oxygen-containing functional groups in the aquatic humic compounds. The values for carboxylic and phenolic hydroxyl groups indicate that the marine fulvic acids have carboxyl group concentrations similar to those of freshwater fulic acids. The carbonyl contents of the sedimentary humic acids studied were much lower than those of either the marine or freshwater humic substances, ranging from 1.2 to 3.0 meq/gram, indicating that the humic material had been extensively altered following deposition. Aquatic humic substances were found to contain substantial amounts of quinone groups. (Baker-FRC)
W83-02008

THE DETERMINATION OF CHEMICAL OXYGEN DEMAND IN WASTEWATERS WITH DICHROMATE BY FLOW INJECTION ANALYSIS,
Okayama Univ. (Japan). School of Engineering.
T. Korenaga, and H. Ikatsu.
Analytica Chimica Acta, Vol 141, p 301-309, 1982. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Chemical oxygen demand, *Water analysis, Wastewater, *Flow injection analysis, Chemical analysis, Oxygen demand, Oxygen, Pollutant identification.

A simple method is described for the continuous determination of chemical oxygen demand (COD) in wastewater samples by flow injection analysis. Samples were injected into a water stream which merges with an acidic dichromate carrier solution. After reaction in a PTFE coil at 120C, absorbances were measured at 445 nm. D-Glucose is satisfactory as a standard substance for COD in a variety of wastewaters. A sampling rate of 15 samples per hour can be achieved, and the detection limit and

precision are 5 mg/liter as COD and 0.4%, respectively. Chloride concentrations of over 100 mg/liter interfere somewhat unless silver and/or mercury salts are added. COD values for various wastewater samples correlate well with those obtained by standard methods using dichromate or permanganate. The method described is suitable for the continuous monitoring of wastewaters. (Baker-FRC)
W83-02009

THE DETERMINATION OF TRACES OF CADMIUM, LEAD AND THALLIUM IN FLY ASH BY POTENTIOMETRIC STRIPPING ANALYSIS,
Aarhus Univ. (Denmark). Dept. of Chemistry.
J. K. Christensen, L. Kryger, and N. Pind.
Analytica Chimica Acta, Vol 141, p 131-146, 1982. 8 Fig, 3 Tab, 21 Ref.

Descriptors: Water analysis, *Fly ash, *Potentiometric stripping analysis, Chemical analysis, *Lead, *Cadmium, *Thallium, Powerplants, Water pollution sources, Pollutant identification.

The suitability of potentiometric stripping analysis for the determination of cadmium, lead and thallium in fly ash and in waters polluted by leaching of fly ash was assessed. By an appropriate choice of medium and of electrolysis potential and by employing a rotating working electrode, it is possible to eliminate interferences from electroactive species often found in fly ash in high concentrations. The accuracy obtained in a study of a certified coal fly ash is satisfactory. (Baker-FRC)
W83-02010

CADMIUM(II) BINDING BY SOIL-DERIVED FULVIC ACID MEASURED BY ANODIC STRIPPING VOLTAMMETRY,
New Hampshire Univ., Durham. Dept. of Chemistry.
G. A. Bhat, and J. H. Weber.
Analytica Chimica Acta, Vol 141, p 95-103, 1982. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Anodic stripping voltammetry, *Cadmium, *Fulvic acid, Organic compounds, Chemical analysis, Water analysis, Soil chemistry, Pollutant identification.

The anodic stripping voltammetry technique has been extended to cadmium-soil fulvic acid binding. Evidence is presented for the initial formation of labile complexes and subsequently of moderately labile complexes. Titrations of aqueous solutions of soil fulvic acid with cadmium ion solutions at pH 6 and 7 reveal unusual shapes in the stripping current vs total cadmium ion curves. The expected inflections occur in the titration curves at specific points. The initial rapid increase in current is attributed to labile cadmium-fulvic acid complexes that contribute to the stripping current by rapid dissociation. Subsequent addition of cadmium ion results in moderately labile complexes, and the stripping current becomes partially kinetically controlled. The stripping current was corrected for kinetic current contributions from dissociation of complexes, and total ligand concentrations, conditional stability constants, and upper slopes were calculated from data well past the titration end-point. The use of upper slopes after kinetic current corrections as in situ calibration curves allowed calculations of equilibrium cadmium concentrations. The data show that both kinetic current corrections and in situ calibration curves are needed to avoid substantial errors in calculations of equilibrium cadmium concentrations from anodic stripping voltammetric experiments. (Baker-FRC)
W83-02011

AUTOMATED DETERMINATION OF NITRATE IN WATERS WITH A REDUCTION COLUMN IN A MICROCOMPUTER-BASED STOPPED-FLOW SAMPLE PROCESSING SYSTEM,
Illinois Univ. at Urbana-Champaign. School of Chemical Sciences.
M. A. Koupparis, K. M. Walczak, and H. V. Malmstadt.
Analytica Chimica Acta, Vol 142, p 119-127, 1982. 5 Tab, 33 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Nitrates, Chemical analysis, Computers, Interference, Cyanide, Dichromates, Iodides, Sulfides, Copper, Tin.

An automated method for the determination of nitrate in waters with a microcomputer-based stopped-flow mixing system is described. Nitrate is reduced to nitrate with a copperized cadmium-silver alloy or cadmium tube column fitted to the stopped-flow system. Nitrite is determined using fast kinetic, multi-point or single-point procedures with N-(1-naphthyl)ethylenediamine dihydrochloride as the color reagent. Reduction time parameters are evaluated and optimized. Water samples in the range of 0.025-3 ppm nitrate-nitrogen can be processed with a throughput of up to 100 samples per hour and a detection limit of 0.013 ppm. Interference studies show that cynanide, dichromate, iodide, sulfide, copper and tin ions cause negative results. (Baker-FRC)
W83-02012

DETERMINATION OF MOLYBDENUM IN NATURAL WATERS AFTER SELECTIVE ADSORPTION ON SEPHADEX GEL,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemistry.
K. Yoshimura, S. Hiraoka, and T. Tarutani.
Analytica Chimica Acta, Vol 142, p 101-107, 1982. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Water analysis, *Atomic absorption spectrometry, *Molybdenum, Natural waters, Natural streams, Lakes, Rivers, Chemical analysis, Spectrophotometry, Pollutant identification.

Molybdenum (VI) ions are adsorbed on Sephadex G-25 gel at pH 3.5, and are desorbed reversibly with a complexing agent, EDTA. The adsorbability is much greater than that for boron (III) and vanadium (V). Large amounts of sodium chloride have little effect on the adsorption. Molybdenum concentrations in natural waters, especially in seawater, can be determined with good precision and accuracy after selective preconcentration of molybdenum by a Sephadex G-25 gel column. The detection limit for 250-ml water samples is about 1 microgram/liter by atomic absorption spectrometry or by spectrophotometry with bromopyrogallol red as reagent. (Baker-FRC)
W83-02013

DETERMINATION OF ARSENIC AND ANTIMONY IN GEOLOGICAL MATERIALS AND NATURAL WATERS BY COPRECIPITATION WITH SELENIUM AND NEUTRON ACTIVATION-GAMMA-SPECTROMETRY,
Dalhousie Univ., Halifax (Nova Scotia). Trace Analysis Research Centre.
C. M. Elson, J. Milley, and A. Chatt.
Analytica Chimica Acta, Vol 142, p 269-275, 1982. 1 Tab, 20 Ref.

Descriptors: *Water analysis, *Neutron activation analysis, *Spectrometry, *Arsenic, *Antimony, Pollutant identification, Natural waters, Natural streams, Lakes, Rivers.

A simple, quantitative method for collecting arsenic and antimony from the digests of geological materials and from salt and fresh waters is described. The procedure involves the addition of selenium(IV) to an acidified sample followed by precipitation of selenium by tin(II) chloride. The precipitate is collected, dried, and irradiated. Arsenic and antimony are quantified directly from the activities of As-76 and Sb-122, respectively. The method has detection limits of 9 ng As and 12 ng Sb per of rock or 500 g of water, and has been applied to eight new reference standards from the US geological Survey. Gold is quantitatively collected by the same procedure. (Baker-FRC)
W83-02014

DETERMINATION OF CHEMICAL OXYGEN DEMAND OF WASTEWATERS WITHOUT THE USE OF MERCURY SALTS,
Southern Water Authority, St. Leonards (England). East Sussex Water and Drainage Div.
D. Ballinger, A. Lloyd, and A. Morrish.
Analyst, Vol 107, No 1278, p 1047-1053, September, 1982. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Chemical oxygen demand, *Wastewater treatment, *Silver nitrate, Mercury, Sulfates, Chlorides, Water analysis, Wastewater analysis, Pollutant identification.

The use of silver nitrate solution to suppress chloride interference in the chemical oxygen demand test is described. Chlorides in wastewater are precipitated as silver chloride, and in this form are only slightly oxidized. The proposed procedure obviates the use of toxic mercury(II) sulfate and is similar to the standard procedure in accuracy and reproducibility of results over a wide range of chloride concentrations. Good agreement with the standard procedure is obtained for samples containing up to 1000 mg/liter of chloride or with a chloride to COD ratio of 3 to 1 or less. Data has also been presented to show that satisfactory agreement may also be possible for chloride to COD ratios of up to 5 to 1. Above this ratio the standard and proposed procedures produce results that are significantly affected by chloride. (Baker-FRC)
W83-02015

ACUTE TOXOCITY OF ORGANIC EXTRACTS OF MUNICIPAL SEWAGE SLUDGE IN MICE,
New York State Coll. of Veterinary Medicine, Ithaca.
For primary bibliographic entry see Field 5C.
W83-02023

MEASUREMENT OF LOW LEVELS OF MOLYBDENUM IN THE ENVIRONMENT BY USING AQUATIC INSECTS,
Western State Coll. of Colorado, Gunnison.
T. Colburn.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 4, p 422-428, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Molybdenum, *Bioassay, *Aquatic insects, Fate of pollutants, Pollutant identification, Bioaccumulation, Accumulation, Gunnison River, *Colorado, Metals.

Aquatic insects collected in the vicinity of the Gunnison River, Colorado, molybdenum lode had Mo concentrations consistent with the geographical location of sampling. Levels varied with the insect species at the same location and were lowest (about 0.20 ppm) at the most upstream and downstream stations. Highest levels were 1.18-1.40 ppm at the site closest to the mine. No Mo was detected in any water samples (detection limit 1 microgram per liter) even after a 40-fold concentration. Water-insect-Mo data can be useful in studying the fate of low levels of Mo pollutants and as tool in Mo prospecting. (Cassar-FRC)
W83-02027

HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF DIFENZOQUAT RESIDUES IN WATER,
Alberta Environmental Center, Vegreville.
I. Ahmad.
Journal of the Association of Official Analytical Chemists, Vol 65, No 5, p 1097-1101, September, 1982. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Chromatography, *Water analysis, *Difenzoquat, Herbicides, Agricultural chemicals, Organic compounds, *Pollutant identification, Chemical analysis.

A procedure is described for the quantitative determination of difenzoquat residues in water. The method is quick, simple and reliable and permits rapid monitoring of difenzoquat in water. The method involves high performance liquid chromatography with ultraviolet detection at 255 nm. The procedure is used to determine 2 ppb to 1 ppm levels of difenzoquat in pure and tap water. Samples which contain more than 50 ppb difenzoquat

are injected directly into the liquid chromotograph without prior separation, concentration, or purification. Samples containing less than 50 ppb difenzoquat are first enriched on C18 Sep-Pak reverse phase cartridges and then injected into the liquid chromatograph. Average recoveries of difenzoquat were greater than 92%, with a coefficient of variation less than 4.5%. The method can be used for water samples with difenzoquat concentrations as low as 2 ppb. (Baker-FRC)
W83-02029

DETECTING AN ALGAL TOXIN BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY,
Hong Kong Polytechnic, Kowloon. Dept. of Civil and Structural Engineering.
S. H. Wong, and E. Hindin.
Journal of the American Water Works Association, Vol 74, No 10, p 528-529, 1982. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Pollutant identification, High performance liquid chromatography, *Algal toxins, *Separation techniques, Bioassays, Water analysis, Toxins, *Chromatography, Organic compounds, Anabaena.

Human gastrointestinal, neurological, respiratory, and allergenic disorders have been reported due to the contamination of drinking water supplies by suspected algal exo- or endo-toxins. Bioassays by small mammals, in the past, have been the only method of detecting the endotoxin, anatoxin-a, produced by Anabaena flos-aquae strain NRC-44-1. A method is decribed for the isolation, detection and quantification of anatoxin-a by high-pressure liquid chromatography (HPLC) with ultraviolet (UV) detection. The endotoxin was isolated from freeze-dried algae by the Devlin method and purified by extraction with chloroform and acidified methanol. HPLC analysis was performed on both a C18 reverse phase column and a Silica-A normal phase column. Fractions of the eluants were collected for six runs and were pooled before bioassay tests of each fraction in mice. Spectrophotometric measurements of anatoxin-a were made at 227 nm. Results showed that the fraction corresponding to the third peak separated on either column gave the same neurotoxic effect on the test animals as that reported for anatoxin-a. Both HPLC columns gave excellent separation at 55 degrees and could be used for isolating and analyzing the nonpurgeable and non-volatile natural organic compounds in water. (Geiger-FRC)
W83-02033

DETERMINATION OF POLYNUCLEAR AROMATIC HYDROCARBONS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Battelle Columbus Div., OH.
P. E. Strup.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-258799, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-600-82-025, September 1982. 5 p, 1 Fig, 3 Tab.

Descriptors: *Wastewater analysis, *Hydrocarbons, *Aromatic compounds, *Liquid chromatography, Industrial wastewater, Municipal wastewater, Fly ash, Sample preservation.

A method for the determination of 16 polynuclear aromatic hydrocarbons (PAH) in wastewater was developed. These 16 PAH were: acenaphthene: benzo(ghi)perylene; fluorene; phenanthrene; dibenzo(ah)anthracene; ideno(1,2,3-cd)pyrene; acenaphthalene; anthracene, benzo(a)anthracene, benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; fluoranthene; naphthalene; and pyrene. This method, based on the use of high performance liquid chromatography with ultraviolet and fluorescence detection, is readily suited for detection of condensed ring aromatics in many types of aquenos samples. Aqueous sources included in this study were flyash wash water, municipal sewage, and industrial effluent samples. Precision and accuracy of the method were estimated from the results of five wastewater samples spiked at levels between 0.1 and 250 ppb for the various PAH compounds. Recoveries were generally 85% or better from these wastewater sources. Storage of several spiked wastewater samples for zero and seven days at various temperatures, pH and chlorine levels, resulted in a matrix of recovery data for the various PAH species. These data indicated that the highest recovery for PAH in wastewater are obtained at a pH species. These data indicated that the highest recovery for PAH in wastewater are obtained at a pH level near 7, in the absence of any chlorine with the analysis being completed as soon after collection as possible. (Moore-SRC)
W83-02038

APPLICATION OF EPA METHOD 610 TO THE ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN LEACHATE SAMPLES,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
D. L. Foerst, B. A. Froning, and T. A. Bellar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-221235, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-041, August 1982. 4 p, 2 Tab.

Descriptors: *Hydrocarbons, *Aromatic compounds, *Leachates, *Sanitary landfills, Landfills, Water analysis, Gas chromatography, Mass spectrometry.

EPA Method 610 was designed for the analysis of 16 polynuclear aromatic hydrocarbon (PNA) compounds in municipal and industrial discharges. Fifteen PNAs were dosed into a sanitary landfill leachate and analyzed using EPA method 610. The PNAs containing two, three, or four fused rings gave recoveries greater than 50%. Those PNAs containing five or six fused rings gave recoveries less than 50%. The leachate matrix was also analyzed by gas chromatography/mass spectrometry (GC/MS) to identify the compounds present in this complex matrix. Forty-three compounds were given a tentative or confirmed identification, but there were 65 additional compounds present in the leachate that could not be identified. Since these leachate samples exhibit a serious matrix effect of low recovery for PNA compounds containing five and six fused rings, further research must be performed to improve the accuracy of the analytical method for measuring the high molecular weight PNA compunds in landfill leachates. (Moore-SRC)
W83-02043

THE CHARACTERIZATION OF THE CHESAPEAKE BAY: A SYSTEMATIC ANALYSIS OF TOXIC TRACE ELEMENTS,
National Bureau of Standards, Washington, DC.
H. M. Kingston, R. R. Greenberg, E. S. Beary, B. R. Hardas, and J. R. Moody.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-265265, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-82-085, October 1982. 3 p, 1 Ref.

Descriptors: *Trace elements, *Chesapeake Bay, *Water chemistry, Estuarine environment, Particulates, Neutron activation analysis, Atomic absorption spectroscopy, Toxic substances, Heavy metals.

As part of a multidisciplinary study of Chesapeake Bay, techniques and procedures were developed to measure trace and toxic element concentrations within the water column throughout the length of Chesapeake Bay. The analysis has been completed for selected elements (Cd, Ce, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sc, Sn, Th, U, and Zn), including some elements at concentrations consistently below one picogram per milliliter. The first stage of study included the developement and construction of a sampling system for the trace metallic elements dissolved in water and filtration system for collecting the particulate elemental component. The second phase consisted of sampling chemical stabilization by acidification and storage of the samples in the field. The total complement of 102 samples was obtained, filtered, acidified, and stabilized. The third major phase consisted of the chemical separation and preparation of samples for the analytical instrumental methods. The fourth major phase consisted of the instrumental analysis of the samples for the trace elements using neutron activation analysis and atomic absorption spectrometry. The fifth major phase involved data reduction and atomic absorption spectrometry. The fifth major phase involved data reduction and evaluation of the statistical significance of blanks. (Moore-SRC)
W83-02044

METHOD DEVELOPMENT FOR DETERMINATION OF POLYCHLORINATED HYDROCARBONS IN MUNICIPAL SLUDGE,
Southwest Research Inst., San Antonio, TX.
C. F. Rodriguez, W. A. McMahon, and R. E. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234071, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-035, September 1982. 5 p, 1 Tab.

Descriptors: *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Halogenated pesticides, *Sludge, DDT, DDE, DDD, Dieldrin, Endrin, Aldrin, Electron capture gas chromatography, Gas Chromatography, Mass spectrometry.

The methodology developed for analysis for chlorinated pesticides and biphenyls consists of extraction of the polychlorinated compounds by liquid-liquid partitioning, cleanup by removal of some interferences by liquid chromatographic column and by precipitation of sulfur with mercury, concentration by evaporation of the extracting solvent, detection and quantification by electron capture gas chromatography, and confirmation of identity by gas chromatography/mass spectrometry. The 17 chlorinated organic compound formulations studied were divided into five groups. Group I was made up of alpha-, beta-, and delta-BHC, p,p'-DDE, p,p'-DDD, p,p-'DDT and heptachlor epoxide. Group II included the compounds gamma-BHC, aldrin, endosulfan I and II, dieldrin, endrin and its aldehyde, and heptachlor. The multicomponent formulation, chlordane, makes up Group III and Group IV is made up of many compounds which together constitute the pesticide toxaphene. Group V was made up of Aroclor 1260, a formulation of a number of polychlorinated biphenyls. The methodology provides a sound basis for the determination of polychlorinated biphenyls and organochlorine pesticides in municipal sewage treatment facilities. The detection limit attained by application of the methodology to a number of different sludges was 0.3 micro g of each single component pesticide per gram of dry sludge and 3 to 15 micro g per gram dry sludge for the multicomponent polychlorinated formulations studied, chlordane, toxaphene, and Aroclor 1260. (Moore-SRC)
W83-02045

APPLICATION AND EVALUATION OF ANALYTICAL PROCEDURES FOR TRACE METALS, TOTAL CYANIDE AND PHENOLICS,
Biospherics, Inc., Rockville, MD.
G. J. Gottfried.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-218512, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-001, August 1982. 3 p. 68-03-2788.

Descriptors: *Trace metals, *Phenols, *Cyanide, *Industrial wastewater, *Wastewater analysis, *Effluents, *Sample preservation, Trace elements, Spectral analysis, Colorimetry.

Analytical procedures for the determination of trace metals, total cyanide, and phenolics were systematically evaluated in a wide variety of industrial effluents to assess their industry-wide applicability. Matrix interferences, methods equivalency, and analytical precision were investigated through

a series of duplicate and spiked analyses on non-diluted and diluted samples. Validation of the methodologies and identification of their limitations were thus established both within specific industrial classifications and across multiple industrial processes. Direct flame aspiration produced the most reliable results of any atomic absorption technique. Graphite furnace and chelation/extraction procedures generally produced reliable results but were more susceptible to matrix effects than direct flame aspiration. Graphite furnace and sodium borohydride hydride generation methods for arsenic and selenium proved acceptable, whereas zinc slurry hydride generation suffered from losses during digestion. The three phenolic methods tested were not equivalent and only 4-AAP colorimetric produced reasonable results. The MBTH colorimetric and instrumental methods were limited by severe matrix interferences or high background signals. The pyridine pyrazolone and pyridine barbituric acid methods for total cyanide produced equivalent results and generally reliable data. Holding times for phenolics and cyanides can be increased from 24 hr to 10 days based on preservation studies. (Moore-SRC)
W83-02047

APPLICATION OF METHODS 606 AND 608 FOR ANALYSIS OF PCBS, ORGANOCHLORINE PESTICIDES AND PHTHALATE ESTERS CONTAINED IN LANDFILL LEACHATES,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
T. A. Bellar, and B. A. Froning.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-227463, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-82-044, August 1982. 4 p, 3 Tab.

Descriptors: *Halogenated pesticides, *Phthalate esters, *Polychlorinated biphenyls, *Leachates, *Water analysis, *Sanitary landfills, Pesticides, Electron capture gas chromatography, Landfills, Ohio.

Methods 606 and 608 are liquid/liquid extraction electron capture gas chromatography methods for the determination of polychlorinated biphenyls (PCBs), organochlorine pesticides and phthalate esters contained in industrial and municipal wastewaters. In order to determine if these procedures are applicable to the determination of priority pollutants in landfill leachates, samples were collected from a large sanitary landfill located in Hamilton County, Ohio. The landfill leachate contained a complex mixture of extractable chemical compounds. Analysis of such extracts without column clean up will irreversibly damage the gas chromatography column. Leachates were spiked with various priority pollutants, and tested by the application of methods 606 and 608. For method 606, recoveries in excess of 70% should be expected with poor relative standard deviation (RSD) for duplicate analyses. At concentrations in excess of 0.5 micro g/l, method 608 worked well for the pesticides tested. Poor recoveries, 30 to 40% less than those for reagent water spikes, were noted for the PCBs. The reason for the poor recovery is as yet unknown. (Moore-SRC)
W83-02048

SOURCES OF PCBS TO WISCONSIN LAKES,
Wisconsin Univ.-Madison. Dept. of Water Chemistry.
D. E. Armstrong, and D. L. Swackhamer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167890, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Technical Report WIS WRC 82-04, Wisconsin University, Madison, 1982. 17 p, 1 Fig, 3 Tab, 36 Ref. OWRT A-084-WIS(1), 14-34-0001-0153.

Descriptors: *Atmospheric pollution, *Lakes, *Water pollution sources, *Polychlorinated biphenyls, Bottom sediments, Fish, *Lake sediments, Model studies, *Sediment analysis, Sediments, *Wisconsin, air pollution, Great Lakes.

The accumulation of polychlorinated biphenyls (PCBs) in Great Lakes fishes has focused attention on the sources of PCBs to the Great Lakes. PCBs are transported in part by air, but the relative importance of atmospheric as compared to tributary and industrial sources is uncertain. Direct measurement of PCB inputs to the Great Lakes is difficult because of the large number of potential tributary and industrial point sources and the problems associated with modeling atmospheric input from measured concentrations of PCBs in air. In the Great Lakes region many lakes can receive PCB input only from atmospheric sources. In particular, seepage lakes located in remote areas are unlikely to receive PCBs from industrial point sources or surface drainage. The purpose of this investigation was to evaluate the importance of atmospheric versus non-atmospheric sources of PCBs to Lake Michigan by comparing Lake Michigan with lakes located in remote areas. PCB concentrations in the surface sediments were compound. This project focused on developing accurate methods for measuring PCBs in lake sediments and obtaining preliminary data on PCB concentrations in contrasting lakes. This report summarizes the method for PCB analysis developed and the preliminary lake sediment data.
W83-02059

APPLICATION OF ELECTROCHEMICAL DETECTORS FOR IMPROVED SENSITIVITY IN HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC SEPARATION AND QUANTITATION OF ULTRATRACE,
Georgia Univ., Athens. Dept. of Chemistry.
J. L. Anderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-168005, Price codes: A03 in paper copy, A01 in microfiche. Georgia Institute of Technology, Environmental Resources Center Report Number ERC 03-82, Atlanta, July 1982. 34 p, 6 Fig, 2 Tab, 29 Ref. OWRT A-090-GA(1), 14-34-0001-1111.

Descriptors: *Carbamate pesticides, *Pesticides, *Urea pesticides, *Coal phenolic residues, *Electrochemical detectors, High performance liquid chromatography, Kelgraf electrode, *Chromatography, *Pollutant identification.

Electrochemical detectors based on a Kel-F-graphite ('Kelgraf') composite working electrode material were developed and applied for liquid chromatographic detection of selected pesticides in the carbamate and urea classes at ultratrace levels in water. Detection limits as low as 50 picograms were achieved for selected carbamate pesticides including Aminocarb and Carbendazim in river water. These detection limits are markedly superior (typically at least 20-fold) to values reported to date by other workers for electrochemical or any other detectors for liquid chromatography. In general, species electrochemically oxidizable with formal potentials less than + 1.1 V vs. Ag/AgCl exhibit detection limits in the subnanogram range. Work on characterization of the Kelgraf electrode revealed that its microparticulate surface structure with islands of graphite active sites surrounded by Kel-F plays an important role in minimizing interference from solvent oxidation current fluctuations, enabling very favorable detection limits to be achieved at the very positive applied potentials used in this work. The electrode structure shows promise for improving detection limits for a wide range of analytes including many not investigated here. A very effective, rapid approach was developed and tested for off-line estimation from a single cyclic voltammogram of the optimum applied potential for an electrochemical flow detector under chromatographic conditions. An improved electrochemical cell design was developed and tested for rapid kinetic measurements on electrochemical systems of interest.
W83-02070

TRACE ENRICHMENT OF FLUORINATED ORGANIC ACIDS USED AS GROUND-WATER TRACERS BY LIQUID CHROMATOGRAPHY,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
K. J. Stetzenbach, S. L. Jensen, and G. M. Thompson.
Environmental Science and Technology, Vol 16, No 5, p 250-254, 1982. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Environmental tracers, *Sample preparation, *Fluorine, Groundwater pollution, *Pollutant identification, *Organic acids, *Chromatography, *Aromatic compounds.

A group of fluorinated aromatic organic acids are used to trace groundwater flow and to monitor waste disposal sites. Current methods for analyzing these organic acids using bonded-phase high-performance liquid chromatrography provide good measurement capability only in the 0.1 to 1.0 parts per million range. A method has now been developed for concentrating the fluorinated aromatic organic acids used as tracers to allow detection at the low parts per billion level while maintaining the ease and precision typical of high-performance liquid chromatography analysis. The currently-used injection-valve sample loop was replaced with a 3-centimeter column packed with an octadecylsilane bonded phase, allowing tracer to be extracted from a large water sample as it is pumped through the injection valve. Tests of this method of sample enrichment for analysis of m-(trifluoromethyl)-benzoic acid, pentafluorobenzoic acid, and benzoate demonstrated that the procedure was rapid, simple, and efficient. For compounds that partition strongly into a hydrocarbon phase, very large concentrating volumes, which result in an increased sensitivity of three or more orders of magnitude, can be used. (Carroll-FRC)
W83-02073

LIQUID CHROMATOGRAPHY WITH PRECOLUMN SAMPLE PRECONCENTRATION AND ELECTROCHEMICAL DETECTION: DETERMINATION OF AROMATIC AMINES IN ENVIRONMENTAL SAMPLES,
Purdue Univ., Lafayette, IN. Dept. of Chemistry.
J. R. Rice, and P. T. Kissinger.
Environmental Science and Technology, Vol 16, No 5, p 263-268, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Environmental tracers, *Sample preparation, *Aromatic compounds, *Pollutant identification, Water pollution, *Chromatography.

Methods currently approved by the Environmental Protection Agency for the preparation of environmental samples containing amine-substituted aromatic compounds have several significant shortcomings. An analytical methodology has been developed which represents a distinct improvement in the technology available for the determination of these pollutants, as well as for many hydrophobic phenols and cresols. The procedure described involves simple filtration of a raw aqueous sample, utilization of a large volume of this for column preconcentration of analytes of interest, separation of these components by reversed-phase liquid chromatography, and quantitation by electrochemical detection. This technique was applied to environmental samples containing low concentrations of the following toxic aromatic amine pollutants: benzidine, 3,3'-dimethoxybenzidine, 4-aminobiphenyl, 3,3'-dichlorobenzidine (DCB), and 4,4'-methylenebis(2-chloroaniline) (MOCA). A complete analytical procedure is described for the determination of benzidine and for 3,3'dimethoxybenzidine, with linearity demonstrated for benzidine added to river water from 25 pg/ml to 5 ng/ml. The limit of detection was found to be 5 pg/ml. More rigorous chromatographic conditions were utilized to determine the other three compounds. Groundwater samples and soil core samples known to contain benzidine and 3,3'-dichlorobenzidine were successfully studied using this approach. No interferences with the amines of interest were observed. (Carrol-FRC)
W83-02092

A NOVEL INTEGRATIVE TECHNIQUE FOR LOCATING AND MONITORING POLYNUCLEAR AROMATIC HYDROCARBON DISCHARGES TO THE AQUATIC ENVIRONMENT,
Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black, T. F. Hart, Jr., and P. J. Black.
Environmental Science and Technology, Vol 16, No 5, p 247-250, 1982. 5 Fig, 22 Ref.

Group 5A—Identification Of Pollutants

Descriptors: *Hydrocarbons, *Water pollution sources, *Monitoring, *Pollutant identification, Substrates, Water analysis, Organic compounds, Chromatography, Sample preparation, *Polynuclear aromatic hydrocarbons, Niagara River, Lake Erie, On-site tests, Path of pollutants, *New York.

A simple, relatively inexpensive analytical technique has been developed for use in locating and integrative monitoring of polynuclear aromatic hydrocarbons in aquatic environments. Polypropylene cut from a commercial oil-adsorbant cloth (3M Brand Oil Sorbant Type 151) were anchored at ten sites on the Niagara River and Lake Erie near suspected sources of polynuclear aromatic hydrocarbon discharges. Mild ethanolic extraction and liquid-liquid partitioning are used to isolate a polynuclear aromatic hydrocarbon containing fraction which is amenable to analysis by high-pressure liquid chromatography. This technique provides an integrated record of the accumulation of polynuclear aromatic hydrocarbons over the time of field exposure. Although efficiencies of the extraction method were in the low range for some of these hydrocarbon compounds, the reproducibility of the substrate technique was excellent. The technique can be used for rapid tracking of these hydrocarbons to their putative sources, followed by more detailed monitoring of specific effluents to determine actual discharge rates. (Carrol-FRC)
W83-02093

5B. Sources Of Pollution

MERCURY AND OTHER HEAVY METALS IN THE WATER: MIGRATION, ACCUMULATION, AND TOXICITY TO AQUATIC ORGANISMS (A REVIEW),
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
F. Ya. Komarovskiy, and L. R. Polishchuk.
Hydrobiological Journal, Vol 16, No 5, p 51-62, 1981, 1 Tab, 115 Ref.

Descriptors: *Heavy metals, *Mercury, *Biological magnification, *Water pollution sources, *Water pollution effects, *Toxicity, *Fate of pollutants, *Literature review, Bioaccumulation, Aquatic populations, Industrial wastes, Bottom sediments, *Reviews, Fungicides.

Heavy metals are dangerous contaminants of natural waters, since they may poison aquatic organisms even at very low concentrations. Sources of heavy metals input into natural water are direct runoff of industrial effluents and transfer of air pollutants to water. Heavy metals may be biologically magnified through the food chain. Some concentrations of mercury (Hg) that have been recorded in freshwater and marine organisms are tabulated. Sources of Hg discharge into water are by industrial effluents, fungicides and by natural sources. Hg concentrates more intensively in aquatic ecosystems than in land systems. Some toxic effects of Hg and Hg compounds are reviewed. Many models for methylmercury accumulation in the food web have been proposed. Some levels of accumulation of heavy metals in bottom sediments are discussed. To define the maximum permissible levels of these metals, it is essential to take into account various factors affecting their toxicity, such as organic content, dissolved oxygen pH, water hardness and temperature. More studies on the migration and accumulation of heavy metals in water, aquatic organisms and sediments are needed to ascertain possible immediated and long term effects on biotic and abiotic components of the environment. In the meantime, the influx of heavy metals into the aquatic environment must be strictly curtailed. (Geiger-FRC)
W83-01755

FLUX OF ALIPHATIC AND POLYCYCLIC AROMATIC HYDROCARBONS TO CENTRAL PUGET SOUND FROM SEATTLE (WEST-POINT) PRIMARY SEWAGE EFFLUENT,
Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
R. C. Barrick.
Environmental Science and Technology, Vol 16, No 10, p 682-692, October 1982, 2 Fig, 5 Tab, 45 Ref.

Descriptors: *Hydrocarbons, *Wastewater pollution, *Storm wastewater, Primary wastewater treatment, Wastewater treatment, *Aliphatic hydrocarbons, *Aromatic hydrocarbons, *Polynuclear aromatic hydrocarbons, Municipal wastewater, Seattle, *Washington, *Puget Sound, Storm runoff, Runoff, Combined sewer overflows, Fallout, Water pollution sources, Fate of pollutants, Alkanes, Urban runoff.

Primary municipal wastewater discharging into Puget Sound from the METRO sewage treatment facility at West Point (Seattle), Washington, contributed 475 metric tons per year of aliphatic hydrocarbons and 1 metric ton per year of 3-7 ring polynuclear aromatic hydrocarbons (PAH). This corresponded to a per capita loading of 2.6 g and 0.005 g per day, respectively. The ratio of particulate to dissolved aliphatic hydrocarbons was 4:1. Both fractions had similar compositions, with n-alkanes of C22 or less dominating. Isoprenoid alkanes, n-alkyl cyclohexanes, steroid hydrocarbons, tri- and diterpenoid hydrocarbons, and unidentified C21-C32 branched alkanes were also found. The major source of the aliphatic hydrocarbons was undergraded fuel oils. Aromatic hydrocarbons were dominated by phenanthrene and its methyl and dimethyl derivatives (particulate fraction) and 1,1'-biphenyl-3-ol (dissolved fraction). A major source of the PAH compounds was street runoff, which contains dust, road wear particles, and automotive oil and grease. The municipal wastewater constituted 2/3 of the total aliphatic hydrocarbon discharging into Puget Sound. Other sources were combined sewer overflows, urban runoff, atmospheric fallout, and discrete discharges from ships and industries. Although PAH inputs are less well defined, municipal wastewater is an important source as well as storm water and combined sewer overflows and atmospheric fallout. In Puget Sound surface sediments accumulations of resolvable alkanes were negligible; phenanthrene plus an unresolved complex mixture, partial; and PAH of 4 or more, substantial. (Cassar-FRC)
W83-01762

CHROMIUM IN WATER, SUSPENDED PARTICLES, SEDIMENTS AND BIOTA IN THE IRAJA RIVER ESTUARY,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
W. C. Pfeiffer, M. Fiszman, L. D. De Lacerda, M. van Weerelt, and N. Carbonell.
Environmental Pollution, Series B, Vol 4, No 3, p 193-205, 1982. 1 Fig, 7 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Chromium, *Bioindicators, *Estuaries, *Bays, *Bottom sediments, *Biological magnification, *Barnacles, Heavy metals, Indicators, Suspended solids, Suspended sediments, Monitoring, *Brazil, Iraja River estuary, Guanabara Bay, Pollutant identification, Outfalls, Spectrophotometry.

The levels of chromium (Cr) in samples of water, suspended particles, bottom sediments, fish (Poecilia reticulata), plants (Paspalum vaginatum, sesuvium portulacastrum, Philoxeros vermicularis), soils, and barnacles (Balanus sp) collected from August 1976 to September 1980 from the Iraja River and its estuary were measured. Sediment and water samples from the Iraja River had Cr levels a thousand times greater than the published data for freshwater systems. Cr was carried by particulate matter to Guanabara Bay. Cr from water of sediments was concentrated by fish and emergent grass and returned to the system as detritus. The vegetal community displayed a concentration factor smaller than that of soil and prevented the return of Cr to the waters of the estuary. Balanus sp. of the Guanabara Bay concentrates Cr in soft tissues 1000 times higher than values found in suspended particles, and may be used as a biological monitor for this heavy metal in estuarine systems. (Geiger-FRC)
W83-01764

MIGRATION OF 1,1,1-TRICHLOROETHANE IN SOIL,
Parma Univ. (Italy). Inst. of Organic Chemistry.
G. P. Gardini, and M. Copelli.
Chemosphere, Vol 11, No 9 p 921-924, September, 1982. 2 Fig, Ref.

Descriptors: *Chlorinated hydrocarbons, *Solvents, *Industrial wastes, Milan, *Italy, *Trichloroethane, Fate of pollutants, Path of pollutants, Organic compounds, Spills.

An industrial plant at Milan. Italy, using large quantities of 1,1,1-trichloroethane (TCE), was investigated to determine the extent of soil contaminated by spillage on the surface and storage in underground concrete tanks. Samples were collected on the surface, in the waste solvent tanks, and in boreholes up to 20 m deep. The maximum depth of TCE penetration was 7 m, in spite of concentrations of 32 ppm TCE directly under the concrete floor. The solvent traveled through the soil mainly in vertical direction, with limited cross-sectional diffusion. Clay layers wee located at the 2-3 m and 5-6 depths. The diffusion rate was 10 to the minus 5th power to 10 to the minus 6th power cm per sec. Conclusions were: (1) concrete waste solvent tanks did not prevent TCE from entering the soil, and (2) this plant was not responsible for the widespread, severe halocarbon groundwater pollution in the Milan area. (Cassar-FRC)
W83-01773

RELATIVE STABILITY OF CARBARYL IN TROPICAL ECOSYSTEMS,
Ife Univ. (Nigeria). Dept. of Microbiology.
O. Odeyemi.
Environmental Pollution, Series A, Vol 29, No 3, p 207-213, November, 1982. 4 Fig, 12 Ref.

Descriptors: *Fate of pollutants, *Carbamate pesticides, *Carbaryl, *Biodegradation, *Pesticide residues, *Ecosystems, *Pesticides kinetics, Pesticides, Insecticides, Degradation, Microbial degradation, Seawater, Wastewater, *Tropical regions, Colorimetry.

The persistence of the insecticide, carbaryl, in various tropical ecosystems was examined by incubating sterile and non-sterile samples of freshwater, sewage, agricultural soil, and seawater with the chemical at levels of 45 milligrams/kilograms under greenhouse conditions for 9 weeks. The residual pesticide in each sample was extracted at 1 week intervals and assayed colorimetrically. Results showed that carbaryl disappeared in sewage water, agricultural soil, and fresh water samples after 42, 53, and 60 days of incubation, respectively, but only 77% of the insecticide disappeared after 63 days of incubation in sea water. Since carbaryl generally disappeared more rapidly in non-sterile than in sterile samples from each ecosystem, the degradation of the pesticide is thought to be partly biological as well as chemical. (Geiger-FRC)
W83-01776

MOBILITY AND BIOAVAILABILITY OF URANIUM MILL TAILINGS CONTAMINANTS,
Los Alamos National Lab., NM.
D. R. Dreesen, J. M. Williams, M. L. Marple, E. S. Gladney, and D. R. Perrin.
Environmental Science and Technology, Vol 16, No 10, p 702-709, October, 1982. 6 Tab, 23 Ref.

Descriptors: *Uranium, Metals, *Radioactive wastes, Fate of pollutants, *Mine wastes, Mills, Leaching, Heavy metals, *Trace metals, Sulfides, Vegetation, Irrigation water, Ponds, Radioisotopes, Bioaccumulation, Accumulation, Groundwater pollution, *Colorado, Carson City, *Path of pollutants.

The presence, mobility in water, and bioavailability of toxic contaminants (trace metals and radionuclides) produced at uranium mills were studied in the laboratory and at an active mill site at Canon City, Colorado. Analysis of mill tailings showed enrichment of U and its analogs. Concentration factors (mill tailings/soil) were 880 for U, 250 for V, 67 for Mo, 50 for Se, and 41 for As. Heavy

metals (Cu, Co, Pb, and Ni) and sulfur were less enriched, with concentration factors of 1.7-14; Ra-226 was enriched by 910 times. Aqueous leaching of alkaline tailings mobilized the anionic species As, Mo, Se, and U. Acid tailings leachates contained appreciable Co and Ni. V did not appear to be very water soluble at the pH's encountered. The degree to which each contaminant was mobilized depended on the type of ore and the milling process (acid or carbonate leach, ore roasting, etc.). The extent of migration depended on the strata underlying tailings ponds and the extent of adsorption or precipitation processes. At the active uranium mill, which used the alkaline leach (carbonate) process, Mo and U concentrations in waters and soils were measured at 4 locations plus a distant, unimpacted site. Highest concentrations of metals found in the water samples were 25 mg per liter Mo in the tailings pond area, seepage collection dam, and land irrigated with contaminated groundwater; 5.8 mg per liter U in the seepage collection dam. In the surface soils up to 200 micrograms per g Mo and 73 micrograms per g U were found at the tailings pond. In vegetation (grasses and annuals) the highest metals levels were 190 micrograms per g Mo and 36 micrograms per g U. (Cassar-FRC)
W83-01777

CHLORINATED HYDROCARBONS AND RADIONUCLIDE CHRONOLOGIES IN SEDIMENTS OF THE HUDSON RIVER AND ESTUARY, NEW YORK,
Lamont-Doherty Geological Observatory, Palisades, NY.
R. F. Bopp, H. J. Simpson, C. R. Olsen, R. M. Trier, and N. Kostyk.
Environmental Science and Technology, Vol 16, No 10, p 666-676, October, 1982. 8 Fig, 6 Tab, 36 Ref.

Descriptors: *Chlorinated hydrocarbons, *Radioisotopes, *Pesticides, Fate of pollutants, Path of pollutants, *Polychlorinated biphenyls, *Hudson River, *New York, Sediment cores, Organic compounds, Aroclors, DDD, Dieldrin, Chloridane.

Polychlorinated biphenyls (PCB's), chlorinated hydrocarbon pesticides, and radionuclides were measured in 6 sediment cores taken from the Hudson River in 1977 and 1977 from kilometer point - 2.4 at New York City to kilometer point +230.7 downstream from the Mowhawk River confluence. During 1950-76 several hundred tons of PCB's were discharged from a capacitor manufacturing plant in the upper basin. The Indian Point nuclear reactor is located at km point 69.5. Maximum PCB concentrations occurred in the core sections corresponding to the early 1970's. For example, at the 230.7 km point the maximum PCB levels at the 30-40 cm sediment depth were 140 + or - 39 ppm Aroclor 1242 and 5.92 + or - 0.21 ppm Aroclor 1254. The levels declined to 33.3 + or - 4.0 and 1.81 + or - 0.33 ppm, respectively, in the 0-10 cm layer. In 1973 a retaining dam downstream from the capacitor plant was removed. Since then surface sediment PCB levels have decreased due to burial and dilution of contaminated sediments with soils from the drainage basin. Sediment core analysis also revealed that levels of chlorinated hydrocarbon pesticides (p,p'-DDD, gamma and alpha chlordane, and dieldrin) and radionuclides from fallout have declined since the mid-1960's, reflecting the decrease in use of these pesticides and the halt in atmospheric nuclear testing. Radionuclide concentrations in core sections representing 1971-75 reflected the maximum releases from the nuclear plant in 1971. (Cassar-FRC)
W83-01778

DEPENDENCE OF SORPTION RATES OF RADIONUCLIDES BY FRESHWATER PLANTS ON THE PH OF THE WATER,
Akademiya Nauk SSSR, Sverdlovsk.
M. Ya. Chebotina, and S. A. Lyubimova.
Hydrobiological Journal, Vol 17, No 5, p 84-88, 1981. 4 Fig, 1 Tab, 16 Ref.

Descriptors: Accumulation, *Cesium radioisotopes, *Iron radioisotopes, *Cobalt radioisotopes, *Strontium radioisotopes, *Soil-water-plant relationships, *Hydrogen ion concentration, Trace elements, Iron, Cobalt, Strontium, Cesium, Uptake, Heavy metals, Radioisotopes, Soil water, *Adsorption.

The accumulation of Fe-59, Co-60, Sr-90, and Cs-137 by fresh-water plants and soils was studied as a function of the pH of the water in laboratory tests. The disturbance of the acid-base conditions of the water over a wide pH range had no significant effect on Cs-137 distribution in the water-plant system or the water-soil system, but produced an appreciable effect of Fe-59, Co-60, and Sr-90 distributions in both systems. One of the most likely mechanisms of the pH effect on Sr-90 accumulation is alterations in the carbonate-bicarbonate equilibrium. Variation in pH over a wide range brings about changes in the state of Fe-59 and Co-60 in solution and generates forms differing in mobility and sorptivity in both water-plant and water-soil systems. (Geiger-FRC)
W83-01786

GROUND WATER QUALITY IN SOUTHEASTERN MINNESOTA,
Minnesota Univ., Minneapolis. School of Public Health.
R. D. Singer, M. T. Osterholm, and C. P. Straub.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-15437, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Bulletin 109, University of Minnesota, St. Paul, October 1982. 45 p, 13 Fig, 4 Tab, 38 Ref. OWRT A-035-MINN(2).

Descriptors: *Groundwater contamination, *Rural water supply, *Health aspects, Indicators, Well construction, Well location, Waterwells, *Water quality, *Minnesota, Karst.

Water quality of 21 private wells in the karst area of southeastern Minnesota was studied from Feb. 1977 to May 1979. The wells were located within a one-township area and were chosen for study following a questionnaire survey by type of construction and aquifer(s) in which they were completed. Thirteen routine and six runoff samples were collected from each well during the study and were examined for 18 biological, physical and chemical parameters. The parameters measured in samples from wells in the Galena Formation had the most variation with total coliform and nitrate nitrogen concentrations exceeding recommended limits for drinking water in 68 and 72 percent of the samples, respectively. Generally, it was found the median routine concentrations of all parameters studied were lower than the median runoff concentrations. There was evidence that the chemical quality of the water in the deeper aquifers supposedly protected by a major aquitard was affected rapidly by surface runoff. The parameters found to be the best indicators of surface water contamination of the aquifers and therefore indicators of possible health effects as a result of consumption of such were: bacterial counts, nitrate nitrogen, turbidity, conductivity, sulfate, chloride, phosphate, total organic carbon, and sulfate/chloride and nitrate nitrogen/chloride ratios.
W83-01791

DEVELOPMENT OF A METHODOLOGY FOR IDENTIFYING CRITICAL NONPOINT POLLUTION AREAS IN AGRICULTURAL WATERSHEDS,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny, T. Daniel, and R. Motschall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154393, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Technical Report WIS WRC 82-03, University of Wisconsin, Madison, 1982. 37 p, 12 Fig, 3 Tab, 45 Ref. OWRT A-082-WIS(1), 14-34-001-0153.

Descriptors: *Agricultural runoff, *Agricultural watersheds, Erosion, *Nonpoint pollution sources, Pollutants, *Sediment transport, Sediment yield, *Wisconsin, *Overland flow, Manure, Waste disposal.

Delivery of sediment and particulate pollutants from diffuse sources is shown to be related to the loss of sediment carrying energy of runoff during the overland flow phase. The loss is caused by the termination of rainfall and by reduction of flow energy during the recession phase of the overland flow hydrograph. Theoretical analyses and experimental measurements have demonstrated that the saturated sediment concentration in overland flow is a function of rainfall erosivity and the runoff flow rate. The hypotheses were verified by field measurements from a small homogeneous watershed. Critical manure management areas (CMMAs) are barnyards and manure disposal areas that are potential contributors to nonpoint pollution. Identifying and ranking a CMMA is a problem for the resource manager involved in solving nonpoint pollution problems on priority watersheds. An ideal method to identify CMMAs must be technically sound, inexpensive, and easy to administer. The goal of this portion of the project was to develop a procedure that identifies CMMAs which drain into intermittent waterways using soil samples.
W83-01793

DISSOLUTION KINETICS OF SURFICIAL MANCOS SHALE-ASSOCIATED ALLUVIUM,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Geography.
J. B. Laronne.
Earth Surface Processes and Landforms, Vol 6, p 541-552, 1981. 4 Fig, 1 Tab, 27 Ref. OWRT B-121-COLO(1), 14-3-001-5061.

Descriptors: *Kinetics, *Alluvium, *Solubility, *Salts, *Sediments, Surface flow, Storm seepage, Arid lands, Saline water, Simulation, Semiarid lands, Equilibrium, Minerals.

Determination of the total quantity of solute production from wildland areas as well as that originating solely from non-point sources is essential in order to ascertain the salinity potential of a given watershed. A laboratory study was undertaken to simulate mineral dissolution in a semiarid, saline environment using highly erodible materials. Functions defining the dissolution rates of saline Mancos Shale-associated alluvium in distilled water follow varying patterns. Dissolution is characterized by an initial high rate constant, by a following phase where rates are reduced drastically, and by a final period of encroachment to equilibrium. Initial dissolution rates increase with increase in salt content and sediment: water ratio. The time necessary to approach equilibrium is found to be directly proportional to the sediment: water ratio. The hydrated sodium and magnesium sulfate minerals provide most of the initial solutes, though not necessarily most of the total solute bulk. Results indicate that the high initial dissolution rate of soluble minerals from alluvium, and particularly from shales in contact with aqueous solutions, is too short-lived to account for most of the solutes occurring in heavily sediment-laden surface flow. Excluding input from slower, usually supersaturated subsurface flow, dissolution from sediment in transport should be a major source of solutes in originally undersaturated and kinetically unequilibrated surface water in semiarid and arid regions. (Moore-SRC)
W83-01841

WATER QUALITY OF THE THREE MAJOR TRIBUTARIES TO THE CHESAPEAKE BAY, THE SUSQUEHANNA, POTOMAC, AND JAMES RIVERS, JANUARY 1979 - APRIL 1981,
Geological Survey, Towson, MD. Water Resources Div.
D. J. Lang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-238593, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-32, May 1982. 64 p, 17 Fig, 20 Tab, 21 Ref.

Descriptors: *Water quality, *Data collections, *Water analysis, *Rivers, *Bays, Sampling, Sites, Storms, Stream discharge, Sediment transport, Sediments, Nutrients, Trace metals, Pesticides, *Chesapeake Bay, Susquehanna River, Potomac River, James River, Conowingo Dam, Fall Line.

Water-quality constituent loads at the Fall Line stations of the Susquehanna, Potomac, and James Rivers, the three major tributaries to the Chesapeake Bay, can be estimated with reasonable accuracy by regression techniques, especially for wet periods of 1 year or more. Net transport of all nutrient species and most other constituents is dominated by a few spring and storm-related high-flow events. Atrazine and 2,4-D are the two herbicides most consistently detected at the Fall Line of the Susquehanna and Potomac Rivers. Concentrations of total residual chlorine and low-molecular-weight, halogenated hydrocarbons at selected sites in estuaries to the upper Bay are generally at or below detection limits. Ammonia concentrations and loads are decreasing at all three Fall Line stations, as is orthophosphate in the Susquehanna and Potomac Rivers. Slight increases in total nitrogen and nitrite plus nitrate concentrations in the Susquehanna River from 1969 to 1980 may warrant continued monitoring. Analyses of data for this report confirm the previous suggestion that when water discharge of the Susquehanna River at Conowingo, Maryland, is below about 400,000 cubic feet per second, sediment, with sorbed nutrients and other constituents, is deposited behind the three hydroelectric dams on this river between Harrisburg, Pennsylvania, and its mouth. Discharges above 400,000 cubic feet per second resuspend these sediments and transport constituent loads to the Bay well in excess of loads transported by the Susquehanna River at Harrisburg. (USGS)
W83-01847

PRODUCTION AND DECOMPOSITION OF FOREST LITTER FALL ON THE APALACHICOLA RIVER FLOOD PLAIN, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, and D. J. Cairns.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $10.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-252, 1982. 73 p, 23 Fig, 10 Tab, 50 Ref.

Descriptors: *Decomposition, *Trees, *Leaves, *Organic matter, Flood plains, Wetbanks, Forest, Litter, Vegetation, Productivity, Cycling nutrients, Detritus, *Florida, Apalachicola River.

Measurements of litter fall (leaves and other particulate organic material) and leaf decomposition were made on the Apalachicola River flood plain in 1979-80. Litter fall was collected monthly in five different forest types in swamp and levee areas. Leaves from 42 species of trees and other plants accounted for 58 percent of total litter fall. The remaining 42 percent was nonleaf material. Average litter fall was 800 grams per square meter per year in the flood plain. Tupelo (Nyssa), baldcypress (Taxodium), and ash (Fraxinus), all swamp-adapted trees, produce over 50 percent of the leaf fall. Common levee species such as sweetgum (Liquidambar styraciflua) and diamond-leaf oak (Quercus laurifolia) are also major contributors to total flood-plain litter fall. Annual flooding of the river provides an important mechanism for mobilization of the litter-fall products. Leaf decomposition rates were greatly reduced in dry environments. Carbon loss was nearly linear over a 6-month period, but nitrogen and phosphorus loss was exponential and nearly complete within 1 month. (USGS)
W83-01849

EVALUATION OF INCREASES IN DISSOLVED SOLIDS IN GROUND WATER, STOVEPIPE WELLS HOTEL, DEATH VALLEY NATIONAL MONUMENT, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W83-01858

DISTRIBUTION OF TOXIC SUBSTANCES IN RIVERS,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. R. Jaffe, F. L. Parker, and D. J. Wilson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 639-649, August, 1982. 5 Fig, 7 Tab, 7 Ref.

Descriptors: *Sampling, *Pesticides, *Vertical distribution, *Pollutant identification, Statistical analysis, Organic compounds, Chlorinated hydrocarbons, Kinetics, Probability distribution, Fate of pollutants, Nested analysis, Adsorption, Suspended sediments, Aldrin, Endrin, Chlordane, Hexachlorobenzene, Rivers, Heptachlor, Dieldrin, Solubility, *Tennessee, Wolf River, Memphis.

A statistical sampling design was used to determine the vertical distribution of hydrophobic organic pollutants in a river. Samples were collected in the Wolf River, Memphis, Tennessee, downstream of a dump used for disposal of pesticides manufacturing wastes before its closing 20 years ago. Since these substances were expected to have a nonhomogeneous vertical distribution due to density differences or adsorption on suspended sediments, samples were taken at different depths (10 each on the surface, mid-depth, and bottom at each location) to analyze the variance on a nested design. The vertical distribution of aldrin and suspended sediment was not uniform, but all other chlorinated compounds studied (hexachlorobenzene, heptachlor, dieldrin, chlordane, and endrin) had uniform vertical distributions. A study of grab sample probability distributions showed that log-normal distribution gave better descriptions of the grab sample distribution than normal distribution. Endrin showed the largest departure from normal distribution. Mean concentrations of the pesticides in bottom sediments were as high as 585 ng per g except for aldrin, which had unrealistically high levels, believed to be an interference during analysis. Pesticides were found adsorbed on suspended sediments, adsorbed on fine sediments, and in solution. No attenuation of the pesticides with distance was seen (possibly due to additional sources or resuspension). However, these compounds could have decay coefficients as high as 0.34 per km without being detected. Partition coefficients ranged from zero to 6 ng per g per liter, not including aldrin. (Cassar-FRC)
W83-01902

DISSIPATION OF 2,4-D RESIDUES IN LARGE RESERVOIRS,
Corps of Engineers, Washington, DC.
E. O. Gangstad.
Journal of Aquatic Plant Management, Vol 20, p 13-16, January, 1982. 3 Tab, 12 Ref.

Descriptors: *Aquatic weed control, *Herbicides, *Pesticide residues, Fate of pollutants, Reservoirs, Water pollution, Weed control, Aquatic plants, Factor analysis, Regression analysis, Mathematical studies, Temperature effects, *2,4-D.

The herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) is the most effective and economical method of controlling Eurasian watermilfoil (Myriophyllum spicatum L.), which has become a very troublesome aquatic weed, presenting a serious and real threat to water resources. The characteristics of representative reservoirs which influence the levels, movement, and persistence of 2,4-D residues following application for control of aquatic weeds were investigated in an attempt to predict where application of this herbicide would be unsafe. Three factors were selected to describe reservoirs treated with 2,4-D: the volume of the water system, selected as an index of potential dilution effects; mean depth, chosen as a crude index of susceptibility to rooted aquatic weed infestation and, as a result, of the potential extent of herbicide application; and mean length of the growing season, selected as an index to temperature effects on herbicide residue degradation. The 2,4-D herbicides were applied to four reservoirs with conventional equipment at rates of 20 to 100 pounds acid equivalent per acre. The 2,4-D residue data for the reservoirs were subjected to stepwise multiple regression analysis. This analysis showed that the multiple correlation was highest with growing season. Correlations between residues and volume and rate were also significant, but to a lesser extent. The depth of the reservoir and the time after application were not significant factors in determining residue levels. The chemical residues in the reservoirs were similar for similar applications, and the standard rate of application (between 20 and 40 pounds acid equivalent per acre) did not produce residues above the tolerance level of 100 parts per billion. (Carroll-FRC)
W83-01932

VOLATILIZATION OF ORGANIC COMPOUNDS FROM STREAMS,
Geological Survey, NSTL Station, MS.
R. E. Rathbun, and D. Y. Tai.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 973-989, October, 1982. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Organic compounds, *Volatilization, Streams, *Ethylene, *Propane, Predicting, Estimating, Mathematical equations, Biochemical oxygen demand, Chemical reactions, Water quality control.

Mass-transfer coefficients for the volatilization of ethylene and propane are correlated with the hydraulic and geometric properties of seven streams, and predictive equations are developed. The equations are evaluated using a normalized root-mean-square error as the criterion of comparison. The two best equations are a two-variable equation containing the energy dissipated per unit mass per unit time and the average depth of flow and a three-variable equation containing the average velocity, the average depth of flow, and the slope of the stream. Procedures for adjusting the ethylene and propane coefficients for other organic compounds are evaluated. These procedures are bases on molecular diffusivity, molecular diameter, or molecular weight. Because of limited data, none of these procedures is extensively verified. Therefore, until additional data become available, it is suggested that the mass transfer coefficient be assumed to be inversely proportional to the square root of the molecular weight. (Baker-FRC)
W83-01943

TEMPERATURE/SEDIMENT MODEL FOR A SHALLOW LAKE,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, S. Dhamotharan, and F. R. Schiebe.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 750-765, October, 1982. 10 Fig, 27 Ref.

Descriptors: *Suspended sediment, *Reservoirs, *Stratification, Water temperature, Temperature, Turbidity, Model studies, Shallow water, Lake Chicot, *Arkansas, Oxbow lakes, Water quality control, Fate of pollutants, Mixing, Albedo, Dissolved solids.

A model (RESQUAL) formulated for the effects of turbid water inflow into Lake Chicot, Arkansas, a shallow oxbow lake, is described. The model was designed to assist in rehabilitation of the lake, which lost its recreational attraction because of a flood in 1927, levee construction, and increases in row cropping in the watershed. The dynamic, unsteady, one-dimensional numerical model predicts water temperature, suspended sediment concentration, and dissolved solids. It considers energy exchange at the air-water interface as the forcing mechanism for stratification and mixing as well as inflow, outflow, and suspended and dissolved material loading from the inflow. The four major submodels predict: (1) surface heat transfer and temperature stratification, (2) suspended sediment diffusion and settling, (3) inflow and outflow in the presence of density stratification, and (4) dissolved material transport. Turbidity in the reservoir increases surface albedo and diffuse radiation attenuation. These affect water temperature and the strength of temperature stratification. The density stratification structure is dominated by water temperature. Suspended and dissolved solids increase water density by very small amounts. Inflowing water, sometimes containing 1000 ppm suspended sediment, can spread on the lake surface. Sinking turbidity currents form, not at highest turbidity, but at lowest inflow water temperature. Predic-

tions of water temperature and suspended sediment concentrations in the lake for a one year period agreed well with observed data. The model may also be used in design of detention basins and sediment trapping basins. (Cassar-FRC)
W83-01945

PREDICTION OF SULFIDE BUILDUP IN SANITARY SEWERS,
Lewis (Buck) Engineering, Inc., Tucson, AZ.
K. E. Kienow, R. D. Pomeroy, and K. K. Kienow.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 923-940, October, 1982. 14 Fig, 1 Tab, 18 Ref.

Descriptors: *Sulfides, *Sewer systems, Equations, Mathematical studies, Los Angeles, *California, Sewers, Gravity studies, Pomeroy-Parkhurst equations, Mathematical equations, Hydrogen sulfide, Gas, *Predicting, Model studies, Sulfur, Sulfates.

A graphical solution is developed for determining sulfide buildup in gravity sanitary sewer pipe. The method utilizes the Pomeroy-Parkhurst equations for sulfide buildup first published in 1977. The Pomeroy-Parkhurst equations are based on studies conducted over the past 20 years in the Los Angeles Sanitation District's system. An extensive bibliography of sulfide generation, effects, and case histories is included. (Baker-FRC)
W83-01946

NITRIFICATION, DENITRIFICATION, AND SORPTION-DESORPTION OF NH SUB 4-N IN SANDS DURING WATER MOVEMENT TO SUBSURFACE DRAINS,
Florida Univ., Gainesville. Dept. of Soil Science.
R. S. Mansell, J. G. A. Fiskell, and D. V. Calvert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167585, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 64, University of Florida, Gainesville, 1982. 80 p, 26 Fig, 17 Tab, 13 Ref, 1 Append. OWRT A-042-FLA(1), 14-34-0001-0110, 14-34-0001-1110.

Descriptors: *Nitrogen, Isotopes, Leaching, Drainage, Tillage, *Fate of pollutants, *Soil water movement, *Nitrification, Sands, *Denitrification, Drains, Sorption, Florida, Citrus crops, *Fertilizers, *Nitrate-nitrogen, *Spodosol, Absorption, Lime.

Isotopically labelled (super 15N-depleted (NH sub 4) sub 2 SO sub 4) N fertilizer was applied at a rate of 115 kg N/ha to a Florida citrus grove located in a subsurface drained Spodosol in order to determine the fate of applied N. The fertilizer was applied to one 0.22-ha field plot each of shallow-tilled (ST), deep-tilled (DT), and deep-limed/tilled (DTL) soil. Analyses of soil, soil solution, drainage water, and citrus leaf samples revealed that much of the NH sub 4-N was nitrified to form NO sub 3-N during the first 42 days after application of fertilizer. Partially because of a local drought, most of the applied N was absorbed by plant roots during the first 134 days and leaching losses in drainage water were less than 4% of the amount applied. Rates of nitrification and N uptake by roots were highest for DTL and lowest for ST treatments. Selective deep tillage with lime incorporation of Spodosols appears to be an effective means to manage fertilizer and water resources for citrus and possibly other agricultural crops without contaminating groundwater supplies.
W83-01955

CHEMICAL PROPERTIES AND MINERALOGICAL CHARACTERISTICS OF SELECTED DREDGED MATERIAL,
Wisconsin Univ.-Madison. Dept. of Soil Science.
S. M. Combs, R. H. Dowdy, S. C. Gupta, W. E. Larson, and R. G. Gast.
Journal of Environmental Quality, Vol II, No 2, p 255-261, April-June, 1982. 2 Fig, 41 Ref.

Descriptors: *Spoil banks, *Chemical properties, *Minerology, *Metals, Heavy metals, Cation exchange, Acidity, Alkalinity, Dredging, Nutrients, Oxides.

Large quantities of sediment must be dredged from U.S. waterways each year. One potential alternative to current methods for the disposal of this dredged material is the use of the dredged spoils for reconditioning of lands marginally suited for agricultural production. The chemical properties, metal contents, and mineralogical characteristics of dredged material from ten fresh-water and estuarine waterways in the eastern and central United States were evaluated as a part of a study of the feasibility of this alternative. Dredged materials ranged from very acidic to alkaline in reaction, with acidity attributed to the oxidation of sulphur and iron ions in the spoils. The cation exchange capacity values of the dredged materials ranged from 1.0 to 33.5 meq per 100 grams, with organic matter contents accounting for about 60% of this variation in fine-textured spoils. Total nitrogen was mainly in organic forms, and the carbon to nitrogen ratios ranged from 13 to 1 to 22 to 1. Variable accumulations of nutrients and metals in the dredged materials reflected contamination levels in the waterways. The levels of aluminum, calcium, potassium, magnesium, phosphorus, and sulfur were generally higher in the dredged material than in reference Minnesota soils, while the levels of cadmium, chromium, nickel, lead, zinc, and copper were substantially higher in the spoils. Manganese concentrations were substantially less in the dredged material than in the soils. Mineralogy varied with geographic location, contributing watershed, and environmental conditions. Kaolinite and illite were present in all dredged material, while the amounts of montmorillonite varied due to some conversion to pedogenic chlorite during sediment drainage. There were indications of precipitation of colloidal-sized hydrous oxide particles and/or surface coatings on clay complexes. (Carroll-FRC)
W83-01970

MONITORING OF A MUNICIPAL SLUDGE ENTRENCHMENT SITE,
Agricultural Research Service, Beltsville, MD. Biological Waste Management and Organic Resources Lab.
L. J. Sikora, W. D. Burge, and J. E. Jones.
Journal of Environmental Quality, Vol 11, No 2, p 321-326, April-June, 1982. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Trenches, *Land disposal, *Sludge disposal, Nitrogen, Heavy metals, Municipal wastewater, Coliforms, Bacteria, Leachates, Nitrogen compounds, Nitrogen removal, Fate of pollutants, Groundwater contamination, On-site studies.

Entrenchment of sewage sludge has raised concerns about groundwater quality due to the high application rates. Raw, highly-limed filter-cake sludge (22% solids) was entrenched in 18 hectares of well-drained silt loam soil at a rate of 2,200 wet metric tons per hectare. Sampling was conducted at 20, 37, and 45 months after entrenchment in order to determine the mineralization and movement of nitrogen and movement of heavy metals, as well as the die-off rates and movement of salmonellae, ascaris ova, and fecal indicators in the entrenched sludge and soil profile. Total nitrogen, ammonium-nitrogen (NH4-N), and chloride levels decreased in the entrenched sludge with time and leached through the soil profile past the lowest sampling point, which was 100 centimeters below the trench bottom. Nitrate-nitrogen also migrated to this lowest sampling point. There was no direct evidence of denitrification. There were only negligible heavy metal losses from the entrenched sludge, probably due to the fact that the pH of the sludge was above 7.0 through the period investigated. A predictive equation based on decreases in sludge total nitrogen was developed for use as a tool for determining the age at which the entrenched sludge was stabilized. Pathogen hazards associated with the entrenched, limed sludge appeared to be minimal, with very low concentrations of fecal coliforms and no detectable ascaris ova. Possible contamination of groundwater by nitrogen leached from the sludge was found to be the major environmental effect of sludge entrenchment. (Carroll-FRC)
W83-01972

ENVIRONMENTAL EFFECTS OF A MEDIUM-FERTILITY 12-MONTH PASTURE PROGRAM: II. NITROGEN,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5G.
W83-01974

PREDICTION OF PHOSPHORUS LOSSES IN RUNOFF FROM SOUTHERN PLAINS WATERSHEDS,
Oklahoma State Univ., Stillwater. Dept. of Agronomy.
A. N. Sharpley, S. J. Smith, and R. G. Menzel.
Journal of Environmental Quality, Vol 11, No 2, p 247-251, April-June, 1982. 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Phosphorus, *Rainfall-runoff relationships, Runoff, *Prediction, Mathematical models, Soil erosion, Watersheds, Grasslands, Cropland, Sediment discharge, Performance evaluation, *Simulation analysis, *Southern Plains, Model studies, *CREAMS model, *Path of pollutants.

Relationships developed from simulated rainfall-runoff experiments on soils collected from several cropland and grassland watersheds in the Southern Plains and used to predict the losses of soluble and particulate phosphorus in runoff from these watersheds were evaluated. Soluble phosphorus was predicted from the water-extractable phosphorus content of surface soil (to a depth of 1 centimeter) collected in March of each year, using a general phosphorus-extraction coefficient covering all of the soils found in the subject watersheds. For individual soils, the phosphorus-extraction coefficient was related to the depth of interaction between surface soil and runoff. The level of phosphorus attached to eroded soil transported in runoff was predicted from the total phosphorus content of surface soil collected in March of each year using phosphorus-enrichment ratios calculated from sediment discharge. The predictions of mean annual soluble and particulate phosphorus concentrations with different fertilizer and watershed management practices, soil types, and vegetative covers. The results indicate that the relationships used in the CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems) model can provide accurate predictions of mean annual soluble and total phosphorus concentrations in runoff. (Carroll-FRC)
W83-01979

MOVEMENT OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
W. E. Emmerich, L. J. Lund, A. L. Page, and A. C. Chang.
Journal of Environmental Quality, Vol 11, No 2, p 174-178, April-June, 1982. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Heavy metals, *Soil columns, *Sludge disposal, Cadmium, Copper, Nickel, Zinc, Land disposal, Digested sludge, Groundwater pollution, Soil columns, *Path of pollutants, *Sewage sludge.

Sewage sludges contain varying amounts of heavy metals, which raises concerns regarding the land application of these sludges. Although considerable research has addressed the application of these sludges to crop land and the subsequent plant uptake of heavy metals, little attention has been given to the possible contamination of groundwater by heavy metals from land application of sewage sludge. The potential for cadmium, copper, nickel, and zinc movement through soil profiles following application of sewage sludge to the surface was investigated using a controlled study with three reconstructed soil columns. Liquid or air-dried anaerobically digested sewage sludge was mixed into the top 15 centimeters of the soil three times for a total rate of 476 metric tons per hectare. The soil columns were leached with 5 meters of Colorado River water over a 25-month period. A complete metal mass balance analysis showed that essentially no metals moved below the depth of incorporation of sludge. Close to 100% of the added metals were recovered in the sludge-soil

layers, and virtually none were recovered below this level of incorporation. The soil profiles beneath the sludge-soil layers exhibited greatly lowered pH, probably due to the mineralization and nitrification of the added organic nitrogen. As a result, a subsequent pH reduction in the sludge-soil layer could increase the solubilization of the metals and induce movement in the soil profiles, even though this was not observed within the time frame of this study. (Carroll-FRC)
W83-01980

ADSORPTION OF REOVIRUS BY MINERALS AND SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. S. Moore, D. H. Taylor, M. M. Reddy, and L. S. Sturman.
Applied and Environmental Microbiology, Vol 44, No 4, p 852-859, October, 1982. 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Viruses, *Land disposal, *Adsorption, *Fate of pollutants, *Soil types, *Minerals, Wastewater disposal, Adsorbents, Cations, Organic matter, Sludge, Pathogens, Separation techniques, Reovirus.

The adsorption of S35-methionine-labeled reovirus by 30 dry soils, minerals, and finely ground rocks suspended in synthetic freshwater at pH7 was studied to determine the conditions needed for optimum virus removal during land application of wastewaters. All of the minerals and soils studied adsorbed over 99% of the virus at 4 degrees after 1 hr. The remaining suspended viruses were significantly inactivated with a three to five log reduction in titer. The presence of divalent cations in the synthetic freshwater increased virus adsorption, while soluble organic matter decreased viral adsorption in secondary effluent. Adsorption increased with increasing available surface area. The inverse correlation between virus adsorption and substrate capacity for cationic polyelectrolyte suggests that the adsorption of infectious reovirus particles is mostly a charged colloidal particle-charged surface interaction, so that the adsorption of polyelectrolyte may be a useful parameter in predicting the fate of viruses during land application of wastewaters and sludges. (Geiger-FRC)
W83-01995

RESIDUES OF O,P'-DDT IN SOUTHERN CALIFORNIA COASTAL SEDIMENTS IN 1971,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. W. Anderson, W. T. Castle, L. A. Woods, Jr., and L. A. Ayres.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 4, p 429-433, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *DDT, *Insecticides, *Sediments, Fate of pollutants, Chlorinated hydrocarbons, *Pesticide residues, *California, Los Angeles, Marine sediments.

Total DDT and four metabolities were determined in intertidal sediments near river outlets off the southern California coast during 1971. Sampling locations were grouped into 2 areas: (1) Los Angeles-Point Conception and (2) the outlier regions north (Monterey) and south of Los Angeles. Total DDT concentrations were: Los Angeles, 0.131 + or - 0.050 ppm; outliers, + or - 0.034 ppm. A significant finding was that o,p'-DDT was present at 0.005 + or - 0.003 ppm in the Los Angeles sediments at a time when biological problems with wildlife were evident. (Cassar-FRC)
W83-02025

PERSISTANCE OF FORMULATED FENITROTHION IN DISTILLED, ESTUARINE, AND LAKE WATER MICROCOSMS IN DYNAMIC AND STATIC SYSTEMS,
Ottawa Univ. (Ontario). Dept. of Biology.
P. Weinberger, R. Greenhalgh, D. Sher, and M. Quellette.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 484-489, 1982. 6 Fig, 17 Ref.

Descriptors: *Pesticides, Chemical degradation, Hydrogen ion concentration, Lakes, *Canada, Estuaries, Streams, Path of pollutants, Fate of pollutants, *Fenitrothion.

Fenitrothion represents a significant percentage of all pesticidal chemicals used in Canada. Tests with natural lake and estuarine water were conducted to investigate the degradation and partitioning of fenitrothion in a dynamic system simulating a stream flowing into a lake or an estuary, into a bay, and in static systems. The fenitrothion was formulated with atlox and mixed with either Aerotex or Dowanol. The chemical reactions in the dynamic system and in the static systems were examined at pH values of 4.5, 6.8, and 8.5. No fenitrothion degradation products were found at any of the three sampling points in the dynamic system, and mass balance analyses indicated that there was no breakdown of the fenitrothion. Dilution and elution were the only factors controlling the concentration of fenitrothion in the dynamic model system, with the pesticide accumulating in the lake or bay downstream from application. Photolysis and hydrolysis of fenitrothion were unaffected by pH or type of water in the static lake and bay models. Degradation in estuarine water was greater than in the other waters, probably due to the ions and/or microflora in the estuarine waters. The study results indicate that the sites downstream of spray areas are highly vulnerable to pesticide perturbations and that laboratory studies using distilled water in the evaluation of chemical degradation of pesticides may be only marginally relevant to processes occurring in natural waters. (Carroll-FRC)
W83-02026

MEASUREMENT OF LOW LEVELS OF MOLYBDENUM IN THE ENVIRONMENT BY USING AQUATIC INSECTS,
Western State Coll. of Colorado, Gunnison.
For primary bibliographic entry see Field 5A.
W83-02027

REAL TIME SIMULATION OF CONDUCTIVITY IN RIVER-LAKE SYSTEMS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, and W. J. Weber, Jr.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers. Vol 108, No EE5, p 1027-1044, October, 1982. 23 Fig, 4 Tab, 17 Ref.

Descriptors: *Model studies, *Pollutant transport, *Fate of pollutants, Water quality, Water pollution control, *Conductivity, Lakes, Dispersion, *Michigan, Ford Lake, Bellesville Lake, Path of pollutants.

Conductivity is modeled in real time in a natural water system using the finite section method. Dispersion coefficients are estimated using methods available in the literature. Calibration is performed together with sensitivity analyses. Small scale effects are defined by a dye study. The resultant model is eventually used in the construction of system models describing the transport and fate of various pollutants in the Ford Lake-Belleville Lake System, Michigan. The methodology presented represents a simpler and less costly procedure for quantifying water mass transport in a advective-dispersive system than the more deterministic methods which involve coupling of momentum conservation and continuity equations to the mass balance equation. For simple systems, such as the one examined in this paper, the use of a simpler modeling approach seems justified. (Baker-FRC)
W83-02034

FIELD-TO-STREAM TRANSPORT OF AGRICULTURAL CHEMICALS AND SEDIMENT IN AN IOWA WATERSHED: PART I. DATA BASE FOR MODEL TESTING (1976-1978),
Iowa State Univ., Ames.
H. P. Johnson, and J. L. Baker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254046, Price codes: A25 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-82-032, September 1982. 4 p, 1 Fig, 3 Tab.

Descriptors: *Agricultural runoff, *Sediments, *Soil erosion, *Pesticides, *Surface runoff, Iowa, Herbicides, Nitrogen compounds, Agricultural chemicals, Agricultural watersheds, Storm seepage, Nonpoint sources, Precipitation, Streamflow.

In order to provide information for testing and evaluating mathematical models under development for predicting agricultural nonpoint source pollution, data were collected for small corn, soybean, and pasture fields; for two larger mixed-cover watersheds; and at three drainage-stream sites. The study area was located in the upper portion of the Four Mile Creek watershed in Tama County, Iowa. Precipitation during the study averaged 92% of normal. Average annual stream-flow from the whole watershed was 124 mm. Sediment losses were also low because of a lack of intense rains, averaging 2.6 t/ha from row-crops and 0.9 t/ha from the watershed as a whole. Average surface runoff losses from pasture, corn, and soybean fields of all dissolved chemicals were less than the amount deposited by precipitation. Because nitrite-nitrogen, chlorine and total dissolved solids were concentrated in subsurface drainage, losses from the watershed as a whole due to streamflow (surface plus subsurface drainage) were significantly larger than losses from surface runoff alone. Average annual pesticide losses from the field were least for the shortest-lived herbicide and greatest for the most persistent. Losses of the herbicides with streamflow from the whole watershed, on a percentage of applied basis, were about 25% of the edge of field losses With the exception of the strongly adsorbed paraquat, at least 80% of the losses occurred in the water phase as opposed to that adsorbed on sediment. (Moore-SRC)
W83-02041

RIVER BASIN VALIDATION OF THE WATER QUALITY ASSESSMENT METHODOLOGY FOR SCREENING NONDESIGNATED 208 AREAS: VOLUMES I AND II,
Midwest Research Inst., Kansas City, MO.
M. J. Davis, M. K. Snyder, and J. W. Nebgen.
Environmental Protection Agency Project Summary EPA-600/S3-82-057, September 1982. 6 p, 3 Tab.

Descriptors: *Water quality, *Nutrients, *Model studies, *Soil erosion, *River basins, Estuaries, Watershed management, Simulation, Mathematical models, Pollution load.

Techniques for estimating diffuse nutrient loads and their water quality effects throughout large watersheds were tested under various field situations for a wide range of data availability circumstances, water quality parameters, and hydrologic-hydraulic conditions, in five river basins, including the Sandusky River in Ohio, the Chester and Patuxent Rivers in Maryland, and the Ware and Occoquan Rivers in Virginia. Obtaining sufficient data to operate the model was the biggest problem in applying the loading methodology to specific river basins. Given the inherent inaccuracy in the basic Universal Soil Loss Equation (USLE) approach, use of the national data base was justified, especially if supplemented with specific county cover (R) factors. Despite the inaccuracies resulting from the use of a national data base, two to three person weeks of effort per basin should produce useful inputs to water quality screening assessments. The loading methods and the water quality methods tested in this study were highly compatible and gave reasonably accurate predictions of instream, lake, and estuary water quality constituent concentrations. The river modeling methods are the most accurate, followed by the techniques for estuaries and then impoundments. Low flow, steady state conditions are better predicted than high flow, unsteady loading situations. Applying these techniques, the watershed management planner should be able to recommend appropriate actions to investigate pollutant problem areas more closely in specific watersheds. (Moore-SRC)
W83-02042

COMPARATIVE ANALYSIS AND DEVELOPMENT OF MODELS FOR GROUNDWATER QUALITY PREDICTION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, and E. S. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167791, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, 1982. 16 p, 74 Ref. OWRT B-074-ARIZ(1), 14-34-0001-9057.

Descriptors: *Mathematical models, *Groundwater pollution, *Advection, *Dispersion, *Groundwater movement, Radioactive wastes, Mathematical equations, Prediction.

The advection-dispersion equation is widely used to describe Fickian transport of pollutants, and in recent years there has been much interest in the possibility of using this equation to predict the effect of groundwater flow on the migration of radio nuclides from geological repositories of nuclear waste to the biosphere. A comparative analysis of numerical approaches to advection-dispersion suggests that these can be broadly classified as Eulerian, Lagrangian, and Eulerian-Lagrangian. In Eulerian methods, the time step size is limited by the Courant-Friedrichs-Lewy condition. Lagrangian methods are based either on a deforming grid, or a fixed grid in deforming coordinates. They usually allow larger time steps than Eulerian methods, and exhibit a lesser degree of oscellation and numerical dispersion. Unfortunately, they are not always well suited for complex problems where multiple concentration fronts propagate through nonuniform two or three dimensional media. For such problems, Eulerian-Lagrangian methods show the greatest promise, as they are able to combine the simplicity of a fixed Eulerian grid with the computational power of the Lagrangian approach. A rigorous theoretical foundation was developed for the Eulerian-Lagrangian method. (Moore-SRC)
W83-02049

SOURCES OF PCBS TO WISCONSIN LAKES,
Wisconsin Univ.-Madison. Dept. of Water Chemistry.
For primary bibliographic entry see Field 5A.
W83-02059

A NOVEL INTEGRATIVE TECHNIQUE FOR LOCATING AND MONITORING POLYNUCLEAR AROMATIC HYDROCARBON DISCHARGES TO THE AQUATIC ENVIRONMENT,
Roswell Park Memorial Inst., Buffalo, NY.
For primary bibliographic entry see Field 5A.
W83-02093

5C. Effects Of Pollution

THE DETERMINATION OF RESIDUAL AMOUNTS OF ORGANOCHLORINE PESTICIDES IN THE RYBINSK RESERVOIR FISH,
Columbia National Fisheries Research Lab., MO.
F. L. Mayer, J. D. Petty, V. I. Kozlovskaya, and B. A. Flerov.
Hydrobiological Journal, Vol 17, No 5, p 63-70, 1981, 5 Tab, 6 Ref.

Descriptors: *Roach, Water pollution effects , *Pike, *Pesticide residues, *Pesticide toxicity, *Halogenated pesticides, Toxicity, Fish, Reservoirs, Farm wastes, Fish physiology, DDT, DDD, Rivers, *USSR, Rybinsk Reservoir, Chesnava River, Udyna River, Gas chromatography, *Pollutant identification.

Pesticides used on croplands adjacent to the Rybinsk Reservoir may enter the reservoir in runoff water and pose a hazard to aquatic organisms. A study was made to determine persistent pesticide residues in fish caught in suspected pollution zones at the mouths of the Chesnava and Udyna Rivers in the Rybinsk River and determine biochemical changes in fish vertebrae which may reflect the physiological condition of the fish. Organochlorine pesticide residues were determined in samples of roach and pike by gas chromatography. Collagen, calcium, and phosphorus were determined in the backbone of each fish, and hydroxyproline was determined on each isolated collagen fraction. Three-year-old roach from the Udyna area contained 1-2 micrograms/gram of pesticide residues, while the Udyna pike contained much less. Both pike and roach from the control area near Borok contained only traces of pesticide residues. The large amounts of pesticides found in roach were attributed to the higher lipid content of the fish plus its manner and frequency of feeding. Fish from the Chesnava river appeared to contain the greatest amounts of chlorinated pesticides. The older fish from all samples contained more pesticide residues than the younger fish. Results of backbone studies revealed no real adverse differences, suggesting that the present use of pesticides on lands near the reservoir is of minor concern. High levels of suspended organic matter in the reservoir may be mediating any possible pesticide effect. (Geiger-FRC)
W83-01754

MERCURY AND OTHER HEAVY METALS IN THE WATER: MIGRATION, ACCUMULATION, AND TOXICITY TO AQUATIC ORGANISMS (A REVIEW),
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W83-01755

DETERMINATION OF EFFLUENT TOXICITY FROM STATE OF PIGMENTED CELLS AND NEURAL APPARATUS OF FISH SKIN,
Volgograd State Medical Inst. (USSR).
For primary bibliographic entry see Field 5A.
W83-01765

THE EFFECTS OF EFFLUENTS OF THE KURSK THERMAL POWER STATION ON ZOOPLANKTON,
All-Union Research Inst. of Pond Fisheries, Rybnoe (USSR).
V. A. Kostylev, and M. A. Yesipova.
Hydrobiological Journal, Vol 17, No 5, p 26-28, 1981. 1 Fig.

Descriptors: *Zooplankton, *Thermal stress, *Thermal pollution, *Thermal powerplants, Temperature effects, Water pollution effects, Plankton, Powerplants, Ecological effects, Thermal water, Fish, *USSR, Kursk thermal power station.

In 1975, 1976, and 1977, a total of 108 zooplankton samples were collected from April to November from fixed points in the warm and cold channels of the Kursk thermal power station to study the effects of the powerplant on the zooplankton and the fish-breeding plant downstream. Zooplankton samples were collected using a Patalas sampling bottle and a plankton net with a No. 76 miller's gauze. Zooplankton biomass was estimated from tables of F. D. Morduhay-Boltovskiy (1954) and S. N. Ulomskiy (1951). Results showed that mechanical damage of zooplankters upon passage through the powerplants, while significant, was probably less of a factor in their mortality than the large thermal gradient between the input and outlet water. The zooplankton from the warm channel provides the 'seed' for the development of zooplankton in the latter ponds. In the zooplankton of the cold channel, Daphnia and rotifers of the genera Asplanchna, Tilinia and Keratella dominated, while in the warm channel, Daphnia and Cyclops (Daphnia longispina, D. magna, and Cyclops sp.) dominated. Toxic agents added to the water also contributed to zooplankton mortality. (Geiger-FRC)
W83-01766

LONG-TERM EFFECTS OF HEAVY METALS ON AQUATIC PLANTS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
M. van der Werff, and M. J. Pruyt.
Chemosphere, Vol 11, No 8, p 727-739, August 1982. 4 Fig, 2 Tab, 46 Ref.

Descriptors: *Uptake, *Aquatic plants, *Heavy metals, *Bioindicators, *Growth, Copper, Zinc, Cadmium, Lead, Submerged plants, Rooted aquatic plants, Metals.

The uptake of low levels of zinc, copper, lead and cadmium by four aquatic plants and the effects of these heavy metals on growth was examined in Elodea nuttallii, Callitriche platycarpa, Spirodela polyrhiza and Lemma gibba. No differentiation in growth or mortality was detected depending on species or elements, except in Elodea, which was sensitive to 5 micromoles of copper. Clear differences were observed between the uptake levels of the heavy metals among species, with greater uptake in the desubmerged plants than in the floating ones. For zinc, lead, and cadmium, an equal ratio was detected between the concentration of the metal in the medium and in the plant tissue independent of the plant species. The roles of roots in metal absorption and the feasibility of using aquatic plants as bioindicators of heavy metal pollution in Dutch waters are discussed. (Geiger-FRC)
W83-01768

THE SPATIAL DISTRIBUTION OF THE FRESHWATER MACROINVERTEBRATE FAUNA OF THE RIVER ELY, SOUTH WALES, IN RELATION TO POLLUTIONAL DISCHARGES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
P. M. Murphy, and R. W. Edwards.
Environmental Pollution, Series A, Vol 29, No 2, p 111-124, October, 1982. 4 Fig, 1 Tab, 46 Ref.

Descriptors: *Macroinvertebrates, *Multivariate analysis, *Species composition, Water pollution effects, Cluster analsis, Nodal analysis, Spatial distribution, Rivers, Ely River, *Wales, Ammonia, Suspended solids, Coal, Coking plants, Wastewater pollution, Organic matter, Benthic fauna, Water quality.

Spatial distribution of macroinvertebrate fauna, sampled in March and July 1977 at 20 sites in the Ely River catchment, Wales, was analyzed by cluster and nodal analysis. This river receives poorly treated sewage at several locations and effluent from two coking plants (ammonia and suspended coal solids). Results of the multivariate analysis showed distinct assemblages inhabiting each of several habitats: unpolluted, organically enriched, recovery, and polluted with coking wastes. At the most severely polluted sites only tubificid species were present. Lowest abundance was associated with unpolluted and severely polluted sites; intermediate abundance with the recovery zone and at sites moderately contaminated with ammonia, suspended solids, and organic wastes; and highest abundance with sites impacted by sewage enrichment alone. Little change in species composition was seen directly downstream of the Royal Mint, which discharges heavy metals into the river. (Cassar-FRC)
W83-01775

CONCENTRATIONS OF HEAVY METALS IN THE TISSUES OF TROUT SALMO TRUTTA AND CHAR SALVELINUS ALPINUS FROM TWO LAKES IN NORTH WALES,
Liverpool Univ. (England). Dept. of Zoology.
I. G. Cowx.
Environmental Pollution, Series A, Vol 29, No 2, p 101-110, October, 1982. 2 Fig, 4 Tab, 26 Ref.

Descriptors: Fish, *Heavy metals, *Lakes, *Trout, *Char, Metals, *Wales, Llyn Peris, Llyn Padarn, *Oligotrophic lakes, Zinc, Iron, Copper, Manganese, *Fate of pollutants, Bioaccumulation, Accumulation, Mine wastes, *Spectrophotometry, Atomic absoprtion spectrophotometry, Pollutant identification.

Heavy metals (Zn, Fe, Mn, and Cu) were determined in scales, bones, liver, kidney, and muscle of brown trout (Salmo trutta L.) and char (Salvelinus alpinus L.) from Llyn Peris and Llyn Padarn, two oligotrophic lakes connected by a 200 m stretch of river in Wales. Metal-containing igneous deposits

and mining were associated with these lakes. Metals levels in the two waters were similar, a maximum of 58 ppm Zn, 60 ppm Fe, 10 ppm Mn, and 2.2 ppm Cu. In both types of fish and in both lakes Mn appeared to be concentrated in bone and scales; Cu in the liver, and Fe in liver and kidney. Zn was more variably distributed, with high levels in scales of both fish and kidney of trout. Trout liver and kidney had higher levels of Zn than char from the same lakes. Trout liver had higher levels of Cu than char liver. In Llyn Peris, char liver had 5 times higher Fe levels than trout liver. Peris char had 4 times higher Fe concentrations in liver than Padarn char. The differences in Fe concentrations in fish from the two lakes possibly related to the existence of distinct char populations. (Cassar-FRC)
W83-01780

MUTAGENIC ACTIVITY OF ORGANIC MATTER IN AN URBAN RIVER SEDIMENT,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, T. Sadamasu, and S. Suzuki.
Environmental Pollution, Series A; Vol 29, No 2, p 91-99, October, 1982. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Organic matter, *Sediments, *Mutagens, Rivers, Organic compounds, Carcinogens, Urban areas, Industrial wastes, Tama River, Tokyo, *Japan, Water pollution effects, Aromatic hydrocarbons, Sediments, Pollutant identification, *Chromatography.

Organic sediments from the Tama River, an industrial river running through Tokyo, Japan, were tested for mutagenic activity. Samples were collected at Wada, a relatively unpolluted upstream location, and at Daishi, a heavily polluted site near the river mouth in Tokyo Bay. Sediments were separated into 14 fractions by solvent extraction and silica gel chromatography. The mutagenicity of the fractions was assayed by the Ames test using strains TA98 and TA100 of Salmonella typhimurium. Total mutagenicity, expressed as micrograms of benzo(a)pyrene, was 32 in the upper river and 360 in the lower river. The basic and neutral water extracts were especially mutagenic. Thin-layer chromatography of the fractions indicated that mutagenicity was attributable primarily to polar compounds containing O and N rather than polycyclic aromatic hydrocarbons. (Cassar-FRC)
W83-01781

FIELD AND EXPERIMENTAL EVALUATION OF ENTEROMORPHA SP. AS A QUALI-QUANTITATIVE MONITORING ORGANISM FOR COPPER AND MERCURY IN ESTUARIES,
Fundacao Univ., Rio Grande (Brazil). Dept. of Oceanography.
U. Seeliger, and C. Cordazzo.
Environmental Pollution, Series A, Vol 29, No 3, p 197-206, November, 1982. 6 Fig, 33 Ref.

Descriptors: *Copper, *Mercury, *Uptake, *Chlorophyta, *Estuaries, *Regression analysis, *Bioindicators, *Fate of pollutants, Heavy metals, Metals, Algae, Bioaccumulation, Accumulation, Retention, Algal growth, *Brazil, Patos Lagoon estuary.

The feasibility of using the green alga, Enteromorpha sp., as a qualitative-quantitative monitor of dissolved inorganic copper (Cu) and mercury (Hg) concentrations in estuarine waters was studied in field and laboratory tests. In the laboratory studies, the uptake and retention of the metals by the algae was examined after exposure of cultures in Fernbach flasks for 6, 12 or 18 days. Field studies monitored the levels of Cu and Hg in algal and water samples taken from four sites in the Patos Lagoon estuary, Brazil. Regression analysis was used to determine correlation factors, and confidence intervals of the mean were calculated for all comparisons of data. Results showed that accumulation of both metals in Enteromorpha followed linear equations with high coefficients of correlation and was directly related to dissolved inorganic forms of Hg and Cu in the medium. The rate of uptake was higher for Cu than for Hg. Loss of Hg and Cu from algal tissues was not significant after 18 days of growth in metal-free medium. Rather, tissue levels of the metals decreased, probably due to increases in Enteromorpha biomass. Salinity changes had not significant effect on metal uptake by the alga, but metal incorporation was reduced by chelation with EDTA. Concentration factors for the metals in the alga derived from field data were used to calculate the expected mean annual dissolved Cu and Hg levels in the estuarine water column. (Geiger-FRC)
W83-01782

DEPENDENCE OF SORPTION RATES OF RADIONUCLIDES BY FRESHWATER PLANTS ON THE PH OF THE WATER,
Akademiya Nauk SSSR, Sverdlovsk.
For primary bibliographic entry see Field 5B.
W83-01786

HAIR MERCURY CONTENTS AND FISH EATING HABITS OF PEOPLE LIVING NEAR A FINNISH MAN-MADE LAKE,
Helsinki Univ. (Finland). Dept. of Environmental Science.
M. Lodenius, and A. Seppanen.
Chemosphere, Vol 11, No 8, p 755-759, August, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Mercury, Fish, *Biological magnification, *Lakes, Heavy metals, Bioaccumulation, Adsorption, Uptake, Pulp wastes, *Finland.

High mercury (Hg) levels have been found in fish from the man-made lake, Lake Kalajarvi in western Finland. At the end of October of 1980, sale of fish from the lake was banned. In February of 1981, 35 hair samples were taken from people who had eaten the Hg-contaminated fish. The samples were divided into 1.5 centimeter long segments starting from the scalp before being analyzed for Hg by cold vapor atomic absorption spectrometry. The mean Hg content in hair of people who ate the contaminated fish was, at a maximum, 6.6 milligrams/kilogram, or about four times higher than that of people who ate fish from unpolluted lakes of northern Finland. Higher levels of Hg in hair samples have been noted in people who ate fish from waters polluted by phenylmercury from the pulp industry. (Geiger-FRC)
W83-01787

METALIMNETIC OXYGEN DEPLETION IN LAKE MEAD AS IT RELATES TO THE LIMNETIC ZOOPLANKTON COMMUNITY,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
T. A. Burke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154476, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Publication No 1, University of Nevada, Reno, February, 1980. 95 p, 14 Tab, 7 Fig, 88 Ref, 1 Append. OWRT A-066-NEV(2), 14-34-0001-6029.

Descriptors: *Zooplankton, Oxygen demand, Limnology, *Metalimnion, *Thermal stratification, Aquatic community oxygen transport, Ecologic considerations, Boulder Basin, *Lake Mead, *Nevada, *Oxygen depletion.

The limnetic zooplankton community of Boulder Basin, Lake Mead, was examined to determine the role of this community in the development of a metalimnetic oxygen minimum which regularly occurs in the lake. Analysis of the community from May 1975 to April 1976 revealed that zooplankton maintain high populations within the metalimnion during summer stratification. The species composition of the community changes noticeably during the summer, but due to advanced stages existing from resting forms, a complete assemblage of individuals are found throughout the 74 day period studied. Thermal stratification was weak, covering a 30 meter metalimnion. Eddy currents powered by wind action brought oxygen into this zone from the surface, and mixing at the metalimnion-hypolimnion due to internal waves and density flows brought oxygen up into this zone. The metalimnion was sactioned into two 15 meter layers. The zooplankton consumed 33 to 69% of the daily oxygen lost from the upper section and 12 to 42% from the lower section of the metalimnion from June 17 to August 28, 1975. The metalimneric oxygen depletion of Boulder Basin is due to the oxygen consumption of the complete aquatic community of producers, consumers, and reducers. The zooplankton, representing the major consumers, account for a significant portion of the oxygen depletion.
W83-01789

IRRIGATION WATER QUALITY OF SOME NATAL RIVERS,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
A. Cass.
Water SA, Vol 8, No 3, p 155-164, July, 1982. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Saline water, *Irrigation water, *Soil solution, *Saline soils, Water quality, Rivers, *Natal, Sodium carbonate, Soil chemistry, Soil water, Rainfall, Evapotranspiration, Drainage, Alkaline soils, Mine drainage.

Irrigation water quality at 43 sites in 29 rivers in 9 catchments in Natal was evaluated, accounting for rainfall, evapotranspiration, soil drainage, and management practices. The four variables used to assess water quality were water salinity and sodicity and soil salinity and sodicity. Data were grouped according to crop salt tolerance and soil sodicity limitations. Results using this method agreed with results from the Ayers (1977) and Christiansen et al. (1977) methods for assessing irrigation water quality. Although most of the water sources were rated good for irrigation by the USSL criteria, only about half were suitable for irrigation under local conditions. The waters tested had enough sodium carbonate to reduce water quality and produce high sodicity, alkaline, soil pH, and poor internal drainage rates in the soil solution. Some of the high sodium carbonate waters had low salt levels, permitting deterioration of hydraulic conductivity in structurally unstable soils. No predominant geographical pattern in water quality was apparent. However, water quality was poorer in areas affected by mining effluents, salt-bearing geological formations, and saline groundwater. (Cassar-FRC)
W83-01826

EFFECT OF HYDRILLA MANAGEMENT BY HERBICIDES ON A PERIPHYTON COMMUNITY,
Florida Univ., Gainesville. Center for Aquatic Sciences.
For primary bibliographic entry see Field 4A.
W83-01891

THE EFFECT OF SOME SOIL SHALE PROCESS WATERS UPON THE VIABILITY OF INDICATOR BACTERIA,
Wyoming Univ., Laramie. Div. of Microbiology and Veterinary Medicine.
J. C. Adams, and D. S. Farrier.
Journal of Environmental Quality, Vol 11, No 2, p 171-174, April-June, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Bioindicators, *Oil shale, *Process water, Industrial wastewater, Bacteria, Coliforms, Streptococcus, Water pollution effects.

The possible biological effects of the release of synfuel process waters to the environment have become an area of increasing concern. It has been suggested that the enumeration of commonly accepted bacterial indicators of pollution might not be appropriate for synfuel process waters. The effects of certain oil shale process waters on total coliforms, fecal coliforms, and fecal streptococci in receiving waters were investigated. The effects of four oil shale process waters on pure cultures of members of total and fecal coliforms and fecal streptococci were studied by inoculating the organisms into various dilutions of the process waters and plating with time on selective and nonselective

media. The effect of the process waters on these organisms in freshly collected water samples was then determined by diluting the water samples with various amounts of process waters and allowing them to stand for 5 hours at 4C. These samples were then processed by standard membrane filtration procedures. The concentration and type of process water determined the effect of the process waters upon the viability of the test bacteria. The general effect of the process waters upon the test bacteria appeared to be lethal rather than injurious, although injury may be possible in some cases. The results with receiving waters suggest that process waters should be diluted at least 1 to 100 in order to minimize any adverse effects on indicator bacteria. Otherwise, underestimates of indicator bacteria are likely in waters that receive spills of the oil shale process waters. (Carroll-FRC)
W83-01915

FACTORS AFFECTING NITRIFICATION IN IOWA RIVERS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
D. B. McDonald, and J. Huey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167551, Price codes: A03 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Ames, ISWRRI Report No 108, November 1982. 21 p, 3 Tab, 1 Ref. OWRT A-071-IA(1), 14-34-0001-9017.

Descriptors: *Nitrification, Rivers, Streams, Laboratory studies, Bacteria, Wastewater disposal, *Iowa, *Nitrifying bacteria, Nitrite, Water pollution sources, Water pollution effects.

This project investigated the effects of physical and chemical factors, other than temperature, on the nitrification process. A series of laboratory studies using pure cultures of nitrifying bacteria were conducted. The effects of changes in the carbonate-bicarbonate level, suspended solids concentrations, turbulence, calcium concentration, tannic acid concentration and leaf extract on the nitrification process were evaluated. Turbulence and suspended solids concentration had no effect on the nitrite production. Nitrite produciton was 50% greater in carbonate buffered solution than solutions with no carbonate-bicarbonate buffer. Tannic acid was toxic to the nitrifying bacteria. Water extract, from oak and hickory leaves enhanced nitrification. These results will help the understanding of the nitrification process in Iowa rivers and streams and the factors that affect the rate of these processes.
W83-01952

CHALK POINT: A CASE STUDY OF THE IMPACT OF BRACKISH WATER COOLING TOWERS ON AN AGRICULTURAL ENVIRONMENT,
Maryland Univ., College Park. Dept. of Agronomy.
C. L. Mulchi, J. A. Armbruster, and D. C. Wolf.
Journal of Environmental Quality, Vol 11, No 2, p 212-220, April-June, 1982. 4 Fig, 7 Tab, 41 Ref.

Descriptors: *Cooling towers, *Brackish water, *Environmental effects, Agricultual, Soil chemistry, Air pollution, Crop yield, Corn, Soybeans, Sodium, Chlorine, Conductivity, Electric power production, *Maryland, Chalk Point.

The Potomac Electric Power Company constructed two brackish water, natural-draft cooling towers at its Chalk Point generating station, which is located in a major agricultural region in Southern Maryland. In response to concern that saline aerosol emissions from the facility might adversely affect the crops and soils near the facility, permanent research and monitoring sites were established at distances of 1.6, 4.8, and 9.6 kilometers north, south, east, and west from one of the cooling towers. Baseline data were collected for 2 years prior to the start of cooling tower operations and postoperational data were collected for 5 years. Data obtained included monthly sodium and chloride deposition rates; foliar chemistry and corn and soybean yields; soil pH and extractable potassium, phosphorus, calcium, magnesium, and sodium; and electrical conductivity values on soil samples from 0 to 15 centimeters of depth. There were no detectable changes in the sodium and chloride deposition rates above baseline values at or beyond the 1.6 kilometer sites following the start of operations. There were no significant changes in the sodium and chloride concentrations in vegetative samples collected from corn and soybean research sites following startup. Significant changes in soil chemistry parameters and significant reductions in corn yields which occurred over time following startup were associated with general increases in soil acidity and rainfall patterns rather than with salt emissions from the cooling tower. The results demonstrate that saline aerosal emissions from this natural draft cooling tower did not have a detectable impact on the agricultural crops and soils adjacent to the emission source. (Carroll-FRC)
W83-01982

SELECTED NUCLEIC ACID PRECURSORS IN STUDIES OF AQUATIC MICOBIAL ECOLOGY,
Hawaii Univ., Honolulu. Dept. of Oceanography.
D. M. Karl.
Applied and Environmental Microbiology, Vol 44, No 4, p 891-902, October, 1982. 3 Fig, 9 Tab, 34 Ref.

Descriptors: *Time series analysis, *Mathematical models, Ecosystems, *Synthesis, *Uptake, *Metabolism, *Prediction, *Radioactive tracers, *Bacteria, Algae, Natural waters, Ecology, Model studies, Synthetic hydrology, Microbiological studies, Ponds, Coastal waters, *Hawaii, Oahu, Manoa.

Several assumptions are examined that must be made when using radiolabeled nucleosides and nucleic acid bases to estimate the rates of RNA and DNA synthesis in naturally occurring microbial assemblages. Conclusions were drawn from results of experiments conducted on bacterial cultures and water samples from several marine and freshwater ecosystems as well as from pure bacterial and algal cultures. Comparative time series analyses of the uptake and incorporation, labeling specificity, and extent of catabolism of tritiated samples of 2-adenine, thymidine, and 5-uridine were studied, along with pathways of labeled thymidine and adenine metabolism. Tritiated thymidine gave the most variable results, especially with regard to the extent of nonspecific macromolecular labeling. The potential significance of the ecological data to be derived from estimates of in situ rates of nucleic acid synthesis more than justifies the amount of research effort that is needed to ensure a proper interpretation of the experimental results obtained in field investigations. (Geiger-FRC)
W83-01994

ACUTE TOXOCITY OF ORGANIC EXTRACTS OF MUNICIPAL SEWAGE SLUDGE IN MICE,
New York State Coll. of Veterinary Medicine, Ithaca.
J. G. Babish, B. Johnson, B. O. Brooks, and D. J. Lisk.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 4, p 379-384, 1982. 1 Tab, 17 Ref.

Descriptors: *Sludge, *Toxicity, Sludge disposal, Land application, Laboratory studies, Mutagenesis, Mortality, Mice, *Bioassay, *Sewage sludge, Municipal wastewater.

The usefulness of a simple bioassay was investigated for characterizing the toxicity of the organic fraction of sludges. Methylene chloride extracts of municipal sludges were evaporated and the residues redissolved in dimethyl sulfoxide (DMSO) for testing in a bacterial mutagen assay and for determination of median LD50 in mice. Animals were dosed intraperitoneally at a constant volume of 0.2 ml per mouse at sludge extract concentrations of 5.2 to 45.9 mg per ml of DMSO. Animals were treated with Boston sludge (106 and 86 revertants per mg extract to Ames Salmonella test TA1537 and TA100, respectively) and a less toxic sludge from Dallas, which had negative results in the Ames test. Median lethal doses were: Boston sludge, 23.4 per kg doses of 14.6-49.3 mg extract per kg; Dallas sludge, 46.5 mg per kg at doses of 25.3-86.0 mg extract per kg. No gross lesions were observed upon necropsy. Both sludge extracts were considered extremely toxic. The toxicity did not correlate with polychlorinated biphenyl levels (0.84 ppm and 1.00 ppm for Boston and Dallas sludges, respectively). This study points out that standards for sludge application on land must be based on a combination of analytical and biological assay, not on determination of a few indicators. (Cassar-FRC)
W83-02023

USE OF XENOPUS LAEVIS LARVAE IN 96-HOUR, FLOW-THROUGH TOXICITY TESTS WITH NAPHTHALENE,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
G. E. Edmisten, and J. A. Bantle.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 4, p 392-399, 1982. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Naphthalene, *Toxicity, *Bioassay, Water pollution effects, *Frogs, Xenopus laevis, Larvae, Aromatic hydrocarbons, Organic compounds, *Bioindicators, Indicators, Sublethal effects.

Larvae of Xenopus laevis (South African clawed frog) were sensitive indicators of naphthalene toxicity in a flow-through bioassay test, suitable as an early indicator of water pollution. The 6-hour EC50 for depigmentation (change from gray to white) was 3.7 mg per liter; the 6-hour EC50 for absence of swimming, 1.7-2.3 mg per liter; the 95-hour LC50, 2.1 mg per liter. Napthalene toxocity behavior and traits were classified into 5 phases, from slightly toxic to lethal. At naphthalene levels of 0.5-1.0 mg per liter the larvae remained in Phase 1. At 3 mg per liter larvae immediately entered Phase 3 or 4, skipping Phases 1 or 2 behavior. At 4.5 per liter Phase 5 occurred within a few hours. EC50 of depigmentation was not well correlated with LC50, but predicted values of EC50 for absence of swimming were within 20% of true LC50 values. (Cassar-FRC)
W83-02024

PERSISTANCE OF FORMULATED FENITROTHION IN DISTILLED, ESTUARINE, AND LAKE WATER MICROCOSMS IN DYNAMIC AND STATIC SYSTEMS,
Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W83-02026

SEDIMENT SUSPENSION AND RESUSPENSION FROM SMALL CRAFT INDUCED TURBULENCE,
Anne Arundel Community Coll., Arnold, MD.
H. Gucinski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-265489, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-82-084, October 1982. 2 p. EPA-78-D-X0426.

Descriptors: *Suspended sediments, *Turbidity, *Boats, *Resuspension, *Light penetration, *Environmental effects, Chesapeake Bay, Submerged plants, Transmissivity, Estuarine environment, Wakes, Turbulence, Waves.

Small vessels operating in shallow waters or with wakes travelling outward to reach shallow waters may have measurable effects in producing increased turbidities as a result of the resuspension of sediments. Increased turbidity may be one of the causative factors for the widespread disappearance of submerged aquatic vegetation (SAV) in the Chesapeake Bay. A two-phase approach was used, consisting of field tests in a suitable sub-estuary of Chesapeake Bay and laboratory measurements of propeller effects. During field trials, two different vessel types were used to make passes at set speeds over known water depths. Before and after measurements of light extinction and transmission, and

determination of gravimetric suspended sediment were used to identify effects. Laboratory experiments were conducted to delineate the contribution of propellers to possible resuspension, using laser-droppler anemometry to map the turbulence field produced by propeller action. The resuspension of sediments in the path of a small craft is influenced by water depth, depth of immersion, size of the propeller, the advance ratio, and the wave-making tendency of the vessel. At depths of greater than 2 m, reduction in SAV productivity was calculated at about 1%. (Moore-SRC)
W83-02039

IMPACT OF A ONCE THROUGH COOLING SYSTEM ON THE YELLOW PERCH STOCK IN THE WESTERN BASIN OF LAKE ERIE,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen, and T. A. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-240284, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-82-072, October 1982. 2 p.

Descriptors: *Entrainment, *Impingement, *Perch, *Cooling, *Powerplants, *Environmental effects, *Mathematical models, Lake Erie, Reproduction, Biomass, Mortality, Fish populations, Fish eggs, Larvae, Cooling water, Fisheries.

Conventional stock assessment models have been applied to determine the impact of entrainment and impingement at the Monroe Power Plant on the yellow perch stock of the western basin of Lake Erie. First the surplus production model was applied. Biological parameters of the model were estimated from commercial catch and effort data, and entrainment and impingement coefficients were estimated from power plant data. The model was used to estimate stock biomass, egg production, and larvae production; the proportions entrained and impinged were then estimated. The impact of water withdrawal on the equilibrium standing stock and maximum sustainable yield from the fishery were estimated and the impacts of increased water withdrawal were simulated. An analytical model was also applied. Parameters of the analytical model was estimated using power plant data, biological data available in the literature and commercial catch data. The model was used to estimate the age structure and biomass of the perch stock and to estimate the impact of the power plant on abundance of the impingeable stock and biomass of the exploited stock. The level of impact was examined under a range of mortality conditions. The two models are much different in terms of mathematical structure and in terms of the data applied for estimation of parameters but give similar estimates of impact of about a 1% to 3% reduction in the size of the exploited stock. (Author's abstract)
W83-02040

CADMIUM AND ENDRIN TOXICITY TO FISH IN WATERS CONTAINING MINERAL FIBERS,
Environmental Research Lab.-Duluth, MN.
A. R. Carlson, J. A. Tucker, V. R. Mattson, G. L. Phipps, and P. M. Cook.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-225038, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-82-053, October 1982. 2 p.

Descriptors: *Toxicity, *Cadmium, *Endrin, *Fish, *Asbestos, *Mine wastes, *Taconite, Biological magnification, Flagfish, Minnows, Suspended solids.

Taconite tailings and their component asbestiform minerals in Lake Superior water had no demonstrable effect on the chronic toxicity of cadmium to the flagfish Jordanella floridae. Maximum acceptable toxicant concentrations determined in life cycle tests, where effects on survival, growth, reproduction, and bioconcentration were used as endpoints, were between 3.3 to 7.4, 3.0 to 6.5, and 3.4 to 7.3 micro g cadmium/L at 0.004, 0.008, and 0.95 mg/L taconite tailings concentrations, respectively. Similarly, in two tests (A and B) exposing recently hatched fathead minnows, Pimephales promelas, for 45 days to several concentrations of endrin, taconite tailings had no observable effect on survival, growth and bioconcentration. No observable effect concentrations (NOEC(s)) for endrin at 0.02 mg/L taconite tailings concentration were between 0.30 and 0.60 micro g/L for group A fish and 0.15 micro g/L for group B fish. At 0.05 mg/L taconite tailings concentration, the NOEC(s) were between 0.30 and 0.60 micro g/L for group A fish and 0.15 and 0.30 micro g/L for group B fish. At the 0.95 mg/L taconite tailings concentration the NOEC(s) were between 0.15 and 0.30 micro g/L for group A fish and 0.30 and 60 micro g/L for group B fish. (Author's abstract)
W83-02046

EFFECTS OF RELEASES OF SEDIMENT FROM RESERVOIRS ON STREAM BIOTA,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
L. J. Gray, and J. V. Ward.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167916, Price codes: A06 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No 116, November 1982. 95 p, 14 Fig, 3 Tab, 57 Ref, 5 Append. OWRT B-226-COLO(2), 14-34-0001-1211.

Descriptors: Reservoirs, *Sediment, *Suspended solids, *Biota, Water quality, *Colorado, *Wyoming, Benthic algae, Microinvertebrates, North Platte River.

Evaluation of temporal and longitudinal effects of sediment releases from reservoirs on downstream physical-chemical conditions, benthic algae, and macroinvertebrates was conducted at Dry Creek Reservoir No 15, Colorado, and North Platte River Guernsey Reservoir, Wyoming. In Dry Creek, flushing of sediments using stored water increased discharge, scoured stream substrates, and altered concentrations of dissolved constituents. Suspended solids increased downstream as substrates were brought into suspension. Algal abundance decreased 90%+ and did not recover for 9 months. Invertebrates were decimated with the initial release. Although full recovery was possible in 2-3 months, further releases reduced recovery rates and shifted community composition to small, fast-growing species. Upstream flows were used to flush sediments from Guernsey Reservoir. Suspended solids concentrations in the North Platte River increased from < 20 mg l- super 1 to > 300 mg l super-1. Because fine particulates remained in suspension, mean particle size of stream substrates was unaltered. Other water quality parameters were unaffected, except for an increase in phosphorus. Higher phosphorus levels contributed to an increase in benthic algae despite reduced light penetration. Densities of chironomids decreases 90%+ during sediment release from increased drift rates and mortality, but densities recovered to initial levels in 3 weeks after the release ended. Densities of mayflies and oligochaetes increased. Changes in benthic populations were highly correlated with changes in suspended solids concentrations.
W83-02061

EFFECT OF PH ON THE GROWTH AND ACTIVITY OF HETEROTROPHIC SEDIMENT MICROORGANISMS,
Waterloo Univ. (Ontario). Dept. of Biology.
M. D. Baker, W. E. Inniss, C. I. Mayfield, and P. T. S. Wong.
Chemosphere, Vol 11, No 10, p 973-983, 1982. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Acidic water, *Bacteria, *Sediments, Water pollution effects, *Hydrogen ion concentration, Lakes, *Lake sediments, Kinetics, Oxygen uptake, Mineralization, Mercury, Lead, Bisulfites, Inhibition, Acid precipitation, Heterotrophic bacteria, Turnover time, Temperature effects, Glucose, Amino acids, Heavy metals, Metals, Plastic Lake, *Ontario.

Heterotrophic microbial activity at low pH was studied in sediments taken from the acidic Plastic Lake, Dorset, Ontario, in October 1979. Oxygen uptake (microliters per g sediment) after 1 hour incubation was 60 at pH 7.5 compared with about 17 at pH 4.5. At the end of 30 min incubation oxygen uptake inhibition in the presence of metals at 60 micrograms per ml of sediment slurry was 41% (Hg) and 6% (Pb) at pH 7.5 and 57% (Hg) and 5% (Pb) at pH 4.5. Bacterial growth was completely inhibited at pH 3.5 and was 90% inhibited at pH 4.5 as compared with growth at pH 7.5. At pH 7.5 Pb at concentrations of 1, 10, and 100 micrograms per ml inhibited bacterial growth by 2, 0, and 13%, respectively. At the same concentrations and pH, Hg inhibited growth by 31, 97, and 100%, respectively. At pH 4.5 inhibition was 0, 87, and 100%, respectively, for the same concentrations of Pb and 100% for all Hg concentrations. Both low temperatures and low pH markedly increased turnover time and decreased Vmax for mineralization of C14-labeled glucose, glycine, and glutamic acid. Turnover times varied from 0.15 hours at pH 7 and 20 C (glutamic acid) to 12.22 hours at pH 4 and zero C. Vmax (micrograms substrate mineralized per g sediment dry weight per hour) varied from 0.40 at zero c and pH 4 (glycine) to 15.97 at pH 7 and 20 C. Bisulfite reduced glucose mineralization at all pH levels, slightly at 1 and 10 micrograms per ml and completely at 10,000 micrograms per ml. (Cassar-FRC)
W83-02076

ELEMENTAL COMPOSITION OF BONE FROM WHITE SUCKER (CATOSTOMUS COMMERSONI) IN RELATION TO LAKE ACIDIFICATION,
Toronto Univ. (Ontario). Dept. of Zoology.
G. A. Fraser, and H. H. Harvey.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 9, p 1289-1296, September, 1982. 2 Fig, 4 Tab, 70 Ref.

Descriptors: *Lakes, *Acidification, *Minerals, *Fish, Calcium, Manganese, Bones, White sucker, Water pollution effects, *Ontario, Acid lakes.

The mineral content of bone was measured in fish captured in three acid (pH < 5.5) and three near neutral lakes in Ontario. The manganese content of hard tissues of white suckers was also examined and related to manganese concentration in water and lake acidification. Bone was found tube decalcified in fish from three acid lakes, while manganese was increased greatly in bone of fish from the most acid lake. The mean centrum calcium content of white suckers captured in George Lake was 16% lower than in white suckers from three lakes with near-neutral pH levels. In two other acid lakes, King and Crosson, centrum calcium was reduced significantly in white suckers. Centrum manganese was elevated fivefold in white sucker from recently acidified George Lake, and tended to be elevated in this species from King Lake. White suckers from George Lake exhibited shorter caudal vertebrae, and some of these fish had deformed caudal fins. These anomalies may be indicative of bone demineralization. All of the study lakes were located in south-central Ontario, including the La Cloche Mountains, North Bay, Algonquin, Haliburton, and Muskoka. (Baker-FRC)
W83-02077

ABILITY OF STANDARD TOXICITY TESTS TO PREDICT THE EFFECTS OF THE INSECTICIDE DIFLUBENZURON ON LABORATORY STREAM COMMUNITIES,
Ecological Analysts, Inc., Concord, CA.
S. R. Hansen, and R. R. Garton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 9, p1273-1288, September, 1982. 9 Fig, 7 Tab, 31 Ref.

Descriptors: *Organic compounds, Water pollution effects, *Population dynamics, *Benthos, *Streams, Rivers, *Diflubenzuron, *Insecticides, Agricultural chemicals, Toxicity.

The abililty of a standard set of freshwater single-species toxicity tests to predict accurately the effects of exposure to diflubenzuron on complex

laboratory stream communities was assessed. The single-species test complied with requirements prescribed for establishing freshwater quality criteria and included nine freshwater animal acute tests, five freshwater animal chronic tests, and one freshwater algal test. The stream communities were stocked from a natural source, equilibrated for 3 months and then treated with diflubenzuron for 5 months. Effects on these stream communities were assessed at the functional group level using biomass and diversity for the analysis. The single-species tests adequately predicted the concentrations of diflubenzuron which affected these stream communities; the most sensitive test species, insects and crustaceans, were up to an order of magnitude more sensitive than the observed community effects. The single-species tests were less successful in predicting the exact nature of tthe community level effects. Those effects resulting from direct lethality to component species were clearly predicted; indirect effects due to altered interspecies could only be predicted with an a priori knowledge of the system's trophic dynamics. (Baker-FRC)
W83-02079

RESPONSE OF TREE SEEDLINGS TO ACID PRECIPITATION - II. EFFECT OF SIMULATED ACIDIFIED CANOPY THROUGHFALL ON SUGAR MAPLE SEEDLING GROWTH,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
D. J. Raynal, J. R. Roman, and W. M. Eichenlaub.
Environmental and Experimental Botany, Vol 22, No 3, p 385-392, 1982. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Acid rain, *Vegetation, *Environmental effects, Rainfall, Air pollution, Fallout, Trees, *Maple sugar trees, Bacteria, Forests, *Tree seedlings.

Sugar maple seedling radicle growth in a laboratory growth apparatus was significantly reduced after exposure to simulated acidified canopy throughfall at pH 3.0 and below. Seedlings exposed to low pH were susceptible to bacterial infection; survival of seedlings transplanted to soil declined with increasing acidity of simulated canopy throughfall. Extension growth and leaf weight gain of established potted seedlings subjected to acidic throughfall was dependent on soil nutrient supplying capacity. Under nutrient-limited conditions, throughfall of pH 3.0 promoted seedling growth, although causing foliar damage. At higher fertility levels, reduction in growth was found only after the pH 2.0 treatment. While these studies indicate that sugar maple seedlings are potentially susceptible to direct and indirect effects of acid precipitation, evaluation of the findings in relation to natural conditions is complicated by the capacity of vegetation and forest floor to buffer the seedling environment from extreme pH changes, the direct effects of acidity on pathogenic microorganisms and the predisposition of seedlings to infection, the episodic nature and varying acidity of precipitation, and differential sensitivity of laboratory and field grown seedlings to acidic deposition. (Baker-FRC)
W83-02091

5D. Waste Treatment Processes

MATHEMATICAL DESCRIPTION OF ADSORPTION OF IDEAL AND REAL ADSORPTIVE MATTER IN FIXED BED FILTERS - PART II (MATHEMATISCHE BESCHREIBUNG DER ADSORPTION IDEALER UND REALER ADSORPTIVE IN FESTBETTFILTERN--TEIL II),
Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Eisenhuettenkunde.
U. Krieger, and M. Mohtadi.
Gas-Wasserfach Wasser-Abwasser, Vol 122, No 12, p 582-588, December 1981, 11 Fig, 7 Ref, English Summary.

Descriptors: *Mathematical models, *Adsorption, *Filters, *Wastewater treatment, *Fixed bed filters, Costs, *Dye industry wastes, *Municipal wastewater, Biological oxygen demand, Chemical oxygen demand, Estimated costs, Biodegradation, Filtration.

A mathematical model is presented to describe adsorption processes occurring in fixed bed filters used for the treatment of organic wastewater. With this type of wastewater, purely physical adsorption is supplemented by biological degradation and mechanical filtration. These three processes are described in the model by simple equations. The model also includes an equation with eight constants that allows calculation of the degree of purification achieved for given contact and operating times. From this, the maximal specific throughput as well as treatment costs as a function of filter time and mean degree of purification achieved can be calculated. The applicability of the model was confirmed by using it to calculate purification achieved and costs for wastewater from a dye factory and for secondary effluent from a mechanical/biological municipal wastewater treatment plant. Reductions in COD and 5-day BOD calculated by the model agreed well with those actually measured. When it was assumed that approximately 50% of investment costs were a linear function of contract time, the model showed that for dye factory wastewater, purification costs decreased with increasing contact time and were at a minimum where the purification costs curve crossed the operating/investment costs curve (at contact times of up to 2 hr.). For municipal wastewater, minimum costs occurred at the adsorption stage. For a cost of 0.10 DM/cu m, 70% of 5-day BOD but only 30% of COD could be removed. It cost over 0.40 DM/cu m to remove 70% of COD. (Gish-FRC)
W83-01751

THE INFLUENCE OF FILTER GRAIN STRUCTURE ON THE BEHAVIOR OF DEEP BED FILTERS (EINFLUSS DER FILTERKORNSTRUKTUR AUF DAS VERHALTEN VON TIEFENFILTERN),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
R. Gimbel.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 220-228, May 1982, 15 Fig, 22 Ref, English summary.

Descriptors: *Filtration, *Filter media, *Structure, Performance evaluation, *Filters, *Wastewater treatment, *Water treatment, Industrial water, Physical properties, Surface geometry, *Liquid deep bed filters.

The influence of grain structure on the performance of liquid deep bed filters is discussed on the basis of fundamental equations describing the macroscopic behavior of the filters. Equations to calculate mass balance, kinetic behavior, and pressure distribution are given, and the application of kinetic equations together with the influence of grain structure on separation processes and pressures loss are discussed. Recent deterministic theories reveal the limited applicability of conventional trajectory calculations to particle deposition. The resulting discrepancies between theory and practice, caused by idealized assumptions in the theory of transport and adhesion mechanisms, are significantly influenced by the geometric surface structure of the filter grains. Experiments on the filtration of quartz particles with filter materials of widely varying surface geometry showed that filter material with a fissured surface, such as coke or pumice, was superior, particularly in regard to its positive influence on pressure loss. The strong influence of particle adhesion was apparent in the experiments; this was especially evident with increasing filter load, and under certain conditions it became the limiting influence. Relatively smooth materials such as glass balls had a low load capacity, and occasionally parts of these broke away, especially when polymer filter aids were used. Materials such as coke and pumice are used mostly for multimedia filters, but in view of these results, replacement of quarz sand by a stronger structed material should also be considered for single medium filters. The optimization alternatives are of use for drinking, industrial, and wastewater treatment. (Gish-FRC)
W83-01752

COMPARATIVE STUDIES WITH CALCIUM AND IRON PRELIMINARY PRECIPITATION IN A TRICKLING FILTER PLANT (VERGLEICHENDE UNTERSUCHUNGEN MIT KALK- UND EISEN-VORFALLUNG AN EINER TROPFKORPERANLAGE),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
P. Wolf, and W. Nordmann.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 255-259, May 1982, 4 Tab, 1 Ref. English Summary.

Descriptors: *Trickling filters, *Precipitation, *Wastewater treatment, *Iron compounds, *Calcium compounds, Municipal wastewater, Phosphorus removal, Biological oxygen demand, Chemical oxygen demand, Hydrogen ion concentration, Filters, Costs.

Preliminary precipitation with calcium and iron was used in a small West German municipal trickling filter plant to improve the efficiency of wastewater treatment. Wastewater inflow to the plant contained 5-day BOD levels of 900-1,200 kg/day, with a peak level during the study period of 1,600 kg/day. To achieve the desired level of water purification, the plant should have received 5-day BOD loads of at most 600 kg/day. In dry weather, the total degree of purification achieved was 60-70%. Using preliminary precipitation with Fe(III) salts of hydrated lime, the purification level was increased to 85-95% in dry weather; however, the effect of precipitation was slight in wet weather. Due to high 5-day BOD (400-700 mg/1) and COD (600-1,100 mg/1) inflow levels, effluent levels were still 60 and 140 mg/1 for 5-day BOD and COD, respectively even with precipitation; on the day with the peak 5-day BOD inflow leel, effluent levels of 5-day BOD and COD were 130 and 205 mg/1, respectively. Despite this, daily 5-day BOD and COD concentrations in water delivered to the receiving stream were reduced from 400 to 50 kg and form 750 to 250 kg, respectively, by iron and calcium (pH 9.0) precipitation. However, with calcium precipitations the formation of calcium carbonate deposits near the dosing point necessitated reduction of the pH to 8.8, which considerably reduced precipitation efficiency. Phosphorus removal was increased from 25-30% to about 70% with calcium precipitation at approximately pH 9 and to 63% with iron precipitation. Sludge volume was increased by about 35% by both forms of precipitation, and digester gas production also increased. The estimated daily savings in cost for the plant were 200 DM for calcium and 350 DM for iron precipitation. (Gish-FRC)
W83-01759

FATE AND EFFECTS OF METHYLENE CHLORIDE IN ACTIVATED SLUDGE,
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
G. M. Klecka.
Applied and Environmental Microbiology, Vol 44, No 3, p 701-707, September 1982, 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Biodegradation, *Activated sludge, *Methylene chloride, Wastewater treatment, Sludge, Organic compounds, Activated sludge process.

The fate and effects of methylene chloride were examined in a system that simulates a municipal wastewater treatment plant. Effects were examined both on the acclimation of activated sludge and on the rate of biodegradation. Additional studies were performed to determine the effect of methylene chloride on the degradation of a readily utilizable test substrate. Activated sludge was acclimated to methylene chloride at concentrations between 1 and 100 mg/1 by continuous exposure to the compound for 9 to 11 days. Rates of methylene chloride degradation were 0.14, 2.3, and 7. mg CH2C12 consumed per h per g of mixed-liquor suspended solids for cultures incubated in the presence of 1, 10, and 100 mg/1, respectively. Concentrations of methylene chloride between 10 and 1,000 mg/1 had no significant effect on oxygen consumption or glucose metabolism by activated sludge. A hypothetical model was developed to examine the sig-

nificance of volatilization and biodegradation for the removal of methylene chloride from an activated sludge reactor. Application of the model indicated that the rate of biodegradation was about 12 times greater than the rate of volatilization. Therefore, biodegradation may be the predominant process determining the fate of methylene chloride in activated sludge systems continuously exposed to the compound. (Baker-FRC)
W83-01769

COMPOSITION AND DEWATERING PROPERTIES OF BIOLOGICAL SLUDGES,
Missouri Univ.-Columbia. Dept. of Civil Engineering.
J. T. Novak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154385, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Columbia, Missouri, December 1982. 84 p, 18 Fig, 7 Tab, 36 Ref. OWRT A-127-MO(1), 14-34-0001-1127.

Descriptors: *Activated sludge, *Biopolymer, *Sludge dewatering, *Wastewater treatment, Molecular weight, Hydrogen ion concentration, Adsorption, *Bioflocculation.

This study was designed to determine the role of biopolymer in sludge dewatering. Free biopolymer was measured as the high molecular weight fraction (excluded by Sephadex G-50 gell) in the supernatant liquor fraction. The study showed that as the fraction of high molecular weight material increased, sludge dewatering rates decreased. This suggested that the resistance to filtration of activated sludge is due to or influenced by the high molecular weight fraction. The supernatant biopolymer also varied with pH. As the pH increased over the natural sludge pH, biopolymer levels increased. Lowering the pH reduced biopolymers. This study indicates that biological floc contains large quantities of adsorbed biopolymer. Adsorption is pH sensitive, being strongest at pH levels near 3. Treatments which reduce biopolymer levels improve sludge dewatering and selective coagulation or precipitation of supernatant biopolymer appears to be the chief role of sludge conditioning agents.
W83-01792

SOME MICROBIOLOGICAL AND CHEMICAL FACTORS INVOLVED IN BIOFLOCCULATION IN THE ACTIVATED SLUDGE TREATMENT OF TEXTILE WASTEWATER,
Auburn Univ., AL.
A. T. Mikell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154435, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, December 1981. 68 p, 11 Fig, 5 Tab, 87 Ref. OWRT A-073-ALA(3), 14-34-0001-0101.

Descriptors: Sewage, Textiles, *Microbial flocculation, *Textile wastes, Effluents, *Wastewater treatment, *Activated sludge, *Flocculation.

An activated sludge facility treating a combination of municipal sewage and waste water from a textile bleachery and dye works was examined for factors that might influence the degree of microbial flocculation and effluent quality. A microbiological examination of prevalent genera was performed to indicate the relative stability in the community structure of populations. The microscopically observable predominance of a filamentous bacterium may contribute to the consistently high SVI (250 - 500 mg/l) of the sludge. This bacterium was not isolated in pure culture or at least in its filamentous form. The virtual absence of ciliated protozoa and the dominance of the small flagellates Bodo sp. and Notoselenus sp. implicate effluent BOD values exceeding 30 mg/l according to the Curds and Cockburn scheme; however, effluent BOD values averaged less than 10 mg/l. The low effluent BOD values at this facility contrast with COD values ranging from 50 - 180 mg/l leading to unusually high COD:BOD ratios. Na super + contributed by the mill affected the settleability of sludge flocs. Settleability improved in direct proportion with the concentration of divalent cations (CaCO sub 3) as shown by jar tests. Exocellular polymer extracted from whole sludge did not differ from that reported by other workers as determined by thin layer chromatography and infrared spectroscopy. A significant variation in the proportion of ionogenic to neutral sugars on different sampling dates was observed.
W83-01800

BACTERIAL ASPECTS OF TEXTILE WASTE ACTIVATED SLUDGE BULKING,
Auburn Univ., AL.
R. L. Allen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154443, Price codes: A05 in paper copy, A01 in microfiche. MS Thesis, December 1980. 82 p, 25 Fig, 12 Tab, 82 Ref, 1 Append. OWRT A-073-ALA(2), 14-34-0001-0101.

Descriptors: *Activated sludge, Textiles, *Microbiology, *Wastewater treatment, *Textile wastes, *Sludge bulking, *Sludge settling, Suspended solids, Bacteria, Microscopy, Municipal wastes, Wastewater treatment plants.

An activated sludge facility treating textile and municipal wastes was investigated microbiologically during periods of both normal sludge settling and sludge bulking. Samples of activated sludge from the aeration basin effluent wier, city and mill influents, and return sludge were examined microbiologically. The samples were sonicated, serially diluted and plated on enrichment media. Total viable numbers (TVN) of bacteria were determined and related to the plant parameters of mixed liquor suspended solids (MLSS), mixed liquor volatile suspended solids (MLVSS), sludge volume index (SVI), and food/microorganism ratio (F/M). Bacteria were isolated from samples obtained during both normal sludge settling and bulking periods and characterized taxonomically. The predominant genera obtained were tested for their ability to flocculate under laboratory conditions in synthetic media and sterilized wastewater. Interference contrast microscopy and scanning electron microscopy were employed in the study.
W83-01801

PLANT UPGRADING FEATURES PHOSPHORUS REMOVAL,
Howard County Dept. of Public Works, MD. Div. of Wastewater Treatment.
E. Goscicki, and R. W. Merriam.
Public Works, Vol 113, No 10, p 55-56, October, 1982. 1 Fig.

Descriptors: *Phosphorus removal, *Pho-Strip process, *Wastewater treatment, Little Patuxent Wastewater Treatment Plant, *Maryland, Microorganisms, Lime, Clarifiers.

The Pho-Strip system for phosphorus removal was incorporated into the recent $52.3 million expansion of the Little Patuxent Wastewater treatment plant in Maryland. Influent concentrations of 10 mg per liter P are reduced to < 1.0 mg per liter phosphate-P (soluble) in the secondary effluent and 0.3 mg per liter phosphate-P (total) in the tertiary filter effluents. The system, with a 15 mgd capacity, includes two 90 ft diameter anoxic strippers and two 50 ft reactor-clarifiers. The process depends on P uptake by microorganisms in the aeration basins, release of P under anoxic conditions in the stripper tanks, and subsequent lime precipitation of phosphorus in the reactor-clarifiers. (Cassar-FRC)
W83-01807

A REVIEW OF DANGEROUS GASES IN SANITARY SEWERS,
Williamsport Sanitary Authority, PA. Wastewater Div.
M. H. Gerardi.
Public Works, Vol 113, No 10, p 34-36, October, 1982. 6 Ref.

Descriptors: *Hydrogen sulfide, *Sewer gas, *Safety, Ammonia, Carbon dioxide, Methane, Oxygen depletion, Hydrocarbons, Wastewater collection, Toxicity, Ventilation, Aerobic conditions, Anaerobic conditions, Manholes.

Hydrogen sulfide poisoning and oxygen depletion are the leading causes of death for sewer workers. Other potentially lethal gases formed by microbial action in the sewers are ammonia (irritating to the eyes and respiratory system), carbon dioxide (causes asphyxiation), and methane (explosive). Gasoline and solvent vapors may be present in sewers serving industrial areas. Production of these gases depends on the composition of the wastewater, flow rate, degree of anaerobic or aerobic conditions, pH, sewer characteristics, and sewer appurtenances. The best ways to protect sewer workers from the effects of dangerous gases are to test the atmosphere before attempting to enter, ventilate the confined space, use appropriate safety equipment, and provide back-up safety personnel. A safety check list is given as an illustration. (Cassar-FRC)
W83-01809

POLLUTION AND ENERGY MANAGEMENT THROUGH THE ANAEROBIC APPROACH,
Bacardi Corp., San Jaun, PR.
L. M. Szendrey, P. E. Schafer, and G. H. Dorion.
Industrial Wastes, Vol 28, No 5, p 31-34, September/October, 1982. 2 Fig, 2 Tab.

Descriptors: *Anaerobic conditions, *Wastewater treatment, Digestion, Anaerobic digestion, Industrial wastes, Food-processing wastes, Biochemical oxygen demand, *Puerto Rico, San Juan, Distillery wastes.

Bacardi Corporation is converting distillery wastes to methane gas using an anaerobic reactor of innovative design. In December of 1981 Bacardi started up a 3 million gallon fixed media anaerobic reactor at its San Juan rum distillery, the world's largest. Currently Bacardi is the only rum producer in Puerto Rico which purifies its wastewater before discharging it into the ocean. The waste to be treated consists primarily of complex spent organic residues from still bottoms, generated by the fermentation and distillation of sugar cane molasses. Bacardi has constructed a three reactor pilot plant which treats distillery waste. Each reactor has a 3,000 gal capacity. The chief purpose of the plant is to operate in parallel with the prototype, while testing a variety of operating conditions and training operators. Experience gained thus far indicates and training operators. Experience gained thus far indicates that the operating costs are from one-fifth to one-tenth of what would be expected from a conventional aerobic system such as an activated sludge system. (Baker-FRC)
W83-01812

MAKING THE MOST OUT OF MOSTO.
Water/Engineering and Management, Vol 129, No 10, p 30-33, September, 1982. 3 Fig.

Descriptors: *Waste recovery, *Recycling, *Anaerobic digestion, *Trickling filters, Pilot plants, *Puerto Rico, Manure, Methane, Wastewater treatment, Biological wastewater treatment, Industrial wastes, Waste disposal, Water pollution control.

In the 1970's when Puerto Rico was faced with problems of rising fuel costs and tighter pollution control measures, the Bacardi Corporation, the island's largest distiller of rum, developed an innovative treatment process to handle wastes at its Catano distillery. The process is based on anaerobic waste treatment technology to produce methane gas and an effluent which can be assimilated by the Atlantic Ocean. During a month, the plant generated enough methane gas to reduce the daily oil consumption of the distillery by almost 90 barrels. The inert wastes are discharged into the Atlantic Ocean via a nearby outfall. The patented biological anaerobic filter process used begins with the transfer of mosto waste (rum slops) from the distillation towers to a holding tank, where it is chemically neutralized. From there it is passed through cooling coils and treated with other chemical before pumping to the anaerobic filter

vessel. Special plastic trickling filter media are the key to smooth functioning of the anaerobic filter. The expected life of the trickling filter is 20 years. THe process is able to go into an idling stage and quickly return to normal throughput rates. The project is being financed by AFICA, a Puerto Rican authority on environmental and medical concerns. A small team of experts is maintained to monitor the progress of the pilot operation. (Geiger-FRC)
W83-01814

MICROSCREENING EXPERIENCES,
Rexnord, Inc., Milwaukee, WI.
J. B. Cravens, and W. A. Lauritch.
Water/Engineering and Management, Vol 129, No 10, p 44-51, September, 1982. 9 Tab, 10 Ref.

Descriptors: *Separation techniques, *Screens, *Filtration, *Secondary wastewater treatment, *Tertiary wastewater treatment, *Performance evaluation, *Pretreatment of water, Wastewater treatment, Water treatment, Suspended solids, Filters, Biological oxygen demand, Advanced wastewater treatment.

Microscreening is used in water and wastewater treatment to separate solids from liquids. Rexnord Incorporated has been conducting field tests on new microscreens for lagoon (algae) and secondary treatment plant upgrading to evaluate their performance as a secondary and tertiary treatment device to maintain biological oxygen demand (BOD)-suspended solids effluent requirements. Microscreens were used to prescreen algae from reservoir water and decrease alum dosage requirements in the late 1950's. In the early 1960's, combined sewer overflow applications of microscreens began. Pulp and paper companies use microscreens to reduce suspended solids for water reuse. In 1977, an algae removal study program using microscreening was initiated across the United States. Microscreens have been used for polishing the final clarifier effluent at the Wisconsin Activated Sludge Secondary Treatment Plant at Kenosha, Wisconsin. Tests at Chesaning Secondary Treatment Plant in Michigan showed that microscreening with 21 micron media directly behind rotating biological contactors without prior clarification can handle the suspended solids loading while maintaining BOD limitations. Some advantages of microscreening over other upgrading methods are discussed. (Geiger-FRC)
W83-01817

THE CCP WAY TO BETTER EFFLUENTS,
M and I, Inc., Fort Collins, CO.
B. A. Hegg, K. L. Rakness, and J. R. Schultz.
Water/Engineering and Management, Vol 129, No 10, p 40-43, September, 1982. 1 Fig.

Descriptors: *Wastewater treatment, Wastewater facilities, *Performance evaluation, *Training, *Operating costs, Maintenance, *Design criteria, Case studies, Wastewater management, Water pollution prevention, Water pollution control, Economic aspects, Biological wastewater treatment, *Composite Correction Program.

Since the passage of the Federal Water Pollution Control Act of 1972, many wastewater pollution control plants have been constructed, and others upgraded to meet specific treatment standards. In a study of 50 western United States treatment facilities, specific problems were found in the areas of operation, maintenance, design and management. On an individual basis, each facility was affected by unique but multiple causes for poor performance. A Composite Correction Program (CCP) was formulated to address all problems that exist at a specific treatment plant. Proper CCP implementation was directly related to improve plant performance. In four case studies, the CCP was implemented at four plants with no major capital improvements. The 8 to 18 month program allowed time for operator training and adjustments in biological treatment systems. The initial step in each CCP was to establish economical performance. To assist owners in making a decision on CCP implementation, a preliminary Performance Potential Evaluation may be made. (Geiger-FRC)
W83-01821

HOW MUCH WATER CLEAN-UP DO WE WANT TO PURCHASE,
Mississippi State Univ., Mississippi State. Div. of Business Research.
L. R. Cheatham.
Mississippi Business Review, Vol XLIII, No 10, p 3-14, April 1982. 8 Tab, 8 Ref. OWRT A-131-MS(2).

Descriptors: *Economic aspects, *Cost analysis, *Water pollution control, *Legislation, *Wastewater disposal, *Industrial wastewater, Mississippi, Environmental protection, Wastewater treatment, Water quality standards, Chemical industry, Pulp and paper industry.

The Federal Water Pollution Control Amendments of 1972 (P.L. 92-500) is the Act which has probably had the greatest impact on instilling the public with an awareness that pollution control legislation produces costs which affect the consumer. The means of pollution prevention and elimination is now the application of effluent discharge standards, and discharge standards have their primary impact on point sources. Sewage disposal systems and industrial firms comprise almost all of this category in Mississippi as well as in other states. These are the units in the economy which are having to bear the direct impact of compliance costs. The burden of water pollution abatement among industrial firms is highly selective. In Mississippi, the Paper and Allied Products (SIC 26) and Chemicals and Allied Products (SIC 28) were responsible for 75.5% of all manufacturing wastewater discharges. The large volume water user groups are more likely to experience impacts from expenditures for abatement equipment because they have to spend a relatively larger percentage of investment funds for this purpose. The largest and most direct impacts of costs of complying with P.L. 92-500 are impacting Mississippi taxpaying consumers through public sewage disposal system expenditures. Compliance costs are a fact of life and are a factor to be considered in determining how much pollution abatement the taxpaying consumer wishes to purchase. (Moore-SRC)
W83-01842

INNOVATIVE FILTER POLISHES OIL REFINERY WASTEWATER,
Hydro Clear Corp., Avon Lake, OH.
J. Irwin, and M. Finkler.
Industrial Wastes, Vol 28, No 4, p 26-27, July/August, 1982. 1 Fig, 4 Tab.

Descriptors: *Oil refineries, *Industrial wastewater, *Filtration, *Wastewater treatment, Tertiary wastewater treatment, Sohio Refinery, Toledo, *Ohio, Grease, Filters, Sand filters, Flotation, Backwash, Oil wastes.

A Hydro Clear pulsed bed rapid sand filter was installed at the Sohio oil refinery, Toledo, Ohio, for polishing the facility's 10.3 mgd wastewater flow. Treatment with separation-skimming, secondary gravity separation, dissolved air flotation, activated sludge process, and clarification produces an effluent with about 20 mg per liter suspended solids (range 25-34 mg per liter). Average suspended solids in the filter effluent are 9 mg per liter (range 6-11 mg per liter). Oil and grease to the filter average 1-3 mg per liter, with removal rates of 20-35%. The filter uses a diffuser to keep the influent solids in suspension, preventing a plating-out effect and plugging of the filter surface. The filter regeneration system forces short air pulses upward through the bed to regenerate the media surface and prolong time between backwashes. The backwash system operates at very low rates (12 gpm per sf) and short duration (3.5 min) and produces 80% less spent backwash water. A separate backwash control system clarifies the spent water and uses chemicals to clean out residual grease and oil. (Cassar-FRC)
W83-01844

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY (1980).
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.

For primary bibliographic entry see Field 5G.
W83-01886

AEROBIC ON-SITE SYSTEMS STUDIED IN NEW MEXICO,
New Mexico Environmental Inst., Las Cruces.
R. Asbury, and C. Hendrickson.
Journal of Environmental Health, Vol 45, No 2, p 86-87, September/October, 1982. 2 Tab.

Descriptors: *Septic tanks, *Aerobic treatment, *Wastewater treatment, *New Mexico, Surveys, Equipment failure.

A survey of 24 New Mexico homes revealed that on-site aerobic disposal systems have more problems than standard septic tank units. Eighteen units were not operating at the time of the survey. Several homeowners reported odor, noise, and mechanical problems. A list of 12 inspections made at a time of home loan applications indicated that 8 were not operating because of equipment failure. These factors indicate that septic tanks have advantages over aerobic systems at sites suitable for subsurface discharge. (Cassar-FRC)
W83-01893

MILWAUKEE METROPOLITAN SEWERAGE DISTRICT, WISCONSIN,
Milwaukee Metropolitan Sewerage District, WI. Treatment Services Div.
S. P. Graef.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1432-1434, October, 1982. 2 Tab.

Descriptors: *Water treatment facilities, *Wastewater treatment, Activated sludge process, Sludge dewatering, Municipal wastewater, *Wisconsin, Milwaukee, Effluents, Water quality.

The Treatment Services Division of the Milwaukee Metropolitan Sewerage District administers the operation and maintenance of the 530,000 cubic meter/day Jones Island Wastewater Treatment Plant and 380,000 cubic meter/day South Shore Wastewater Treatment Plant. The monitoring of wastewater, effluent, sludge, solids, and the lawn and turf fertilizer Milorganite come under the control of this district. Also, the utilization and handling of waste materials in the form of filter cake, sludge, and Milorganite must be supervised. Currently facing the district is involvement in the $1.6 billion Water Pollution Abatement Program. Steps which will be taken at the wastewater treatment plants to ensure compliance with the effluent quality standards are cited. (Baker-FRC)
W83-01894

ANAEROBIC-FILTER PRETREATMENT KINETICS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, C. E. Strubler, and T. Ruzicka.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 900-912, October, 1982. 9 Fig, 3 Tab, 11 Ref.

Descriptors: *Anaerobic conditions, *Filters, *Kinetics, Biochemical oxygen demand, Anaerobic digestion, Wastewater treatment, Suspended solids, Fermentation.

Pilot studies conducted with synthetic and actual dairy wastewater showed that anaerobic-filter pretreatment at ambient temperature was capable of reducing total BOD by up to 96%. Analysis of the reactor kinetics showed that the reactions were complete in about two days detention time, which corresponded to a volumetric loading of 1.7 kg COD/cubic meter per day. Because of declining marginal removals with increased detention time, simple kinetic expressions were not appropriate representations of the reactor performance. Fermentative reactions dominated during the first 0.75 days of treatment, while methanogenic reactions dominated thereafter. Although effluent quality deteriorated, the anaerobic filters could handle a severe shock load as long as sufficient alkalinity

had been added to keep the pH above 6.8 throughout the reactor. (Baker-FRC)
W83-01897

ADSORPTION ISOTHERM PARAMETER ESTIMATION,
Indianapolis Public Works Dept., IN. Liquid Waste Div.
M. W. Sweeney, W. A. Melville, B. Trgovcich, and C. P. L. Grady, Jr.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 913-922, October, 1982. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Estimating, *Isotherms, *Adsorption, Wastewater treatment, Water treatment, *Langmuir equations, Thermocline, Temperature gradient, *Freundlich equations, Mathematical equations, Least squares method, Mathematical studies.

Determination of the parameter values for the Langmuir and Freundlich adsorption isotherm equations for water and wastewater treatment samples often requires estimation of the concentration of nonadsorbable material. Present techniques for estimating the concentration of the material can introduce bias into the data. Furthermore, linearization of the isotherm equations usually leads to application of least-squares analysis to variables other than the true dependent and independent variables. A nonlinear programming technique is presented which allows simultaneous evaluation of the concentration of nonadsorbable material and the isotherm parameters. The technique is based upon the flexible polyhedron concept and achieves minimization of the sum of squares error term associated with the solute concentration when expressed as a function of the adsorbent concentration. (Baker-FRC)
W83-01898

MAXIMIZING ALGAL YIELD IN HIGH-RATE OXIDATION PONDS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, and G. Shelef.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 730-738, August, 1982. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Oxidation ponds, *Algae, Economic aspects, *Wastewater treatment, Aquaculture, *Retention time, Water depth, *Israel, Wastewater irrigation, Optimization, Ponds.

A procedure for determining the best combination of retention time and effluent depth in operating high rate oxidation ponds is described. Data was obtained from pilot and field ponds in Israel and from computer simulations. These parameters are related to sensitivity of the system to light penetration into the pond, the efficiency of biodegradation, the rate of algal growth, algal washout, ambient temperature, and the criteria for reuse of effluent. The objective of the system is maximum net income. The practical range for retention time is 1.8-8 days and for depth 0.2-0.9 m, producing a retention time/pond depth ratio of 6-12. The financial return on the algae sold as animal feed varies from 3 to 4.5
W83-01899

SCRUBBING ODORS FROM WASTEWATER TREATMENT,
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
A. B. M. Shahalam.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 785-799, August, 1982. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Odor control, *Scrubber systems, *Sewer gases, Wastewater treatment, Hydrogen sulfide, Sodium hypochlorite, Sodium hydroxide.

A sewage odor treatment method using a two-stage chemical wet scrubber system was tested in pilot plant studies. The odorous gases, obtained from the wet well of 180 mgd domestic sewage treatment plant, were first passed through a sodium hypochlorite solution (concentration, 0.1-0.23%, optimum, 0.1%) and then through sodium hydroxide solution at pH 10.5-11.6. Odors were reduced by 85-95%. Odor intensity was a function of sewage temperature and oxidation-reduction potential; it was not dependent on sulfide concentration. The effluent air, characterized by gas chromatography-mass spectrometry, contained aliphatic hydrocarbons and chlorinated hydrocarbons at the ppb and ppt levels. Measurements of hydrogen sulfide in the effluent air on several occasions indicated levels of 0-2 ppm. Hydrogen sulfide levels were not correlated with threshold odor, and therefore sodium hypochlorite requirements cannot be based solely on hydrogen sulfide concentrations. (Cassar-FRC)
W83-01900

CHARACTERISTICS OF FILL-AND-DRAW REACTOR,
Sigma Resource Consultants Ltd., Vancouver (British Columbia).
R. Zapf-Gilje, and D. S. Mavinic.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 808-812, August, 1982. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Leachates, *Biological wastewater treatment, *Fill-and-draw reactors, Wastewater treatment, Batch reactors, Laboratory equipment, Landfills, Metals, Settling velocity, Organic loading.

Two removal systems governed fill-and-draw reactors, widely used for investigation of biological treatability of wastewater. Zero-order metal oxidation dominated the initial 1/6 of the cycle and microbial growth the remainder. Landfill leachates (13,640 mg per liter BOD and 19,250 mg per liter COD) were used in 6-liter reactors with fill-and-draw cycles of 12 hours and 24 hours. During each leachate addition there was a transition period of 1/4 the cycle time, after which the system recovered. By the end of the first 1/4 of the cycle organic removal and metal oxidation were virtually complete. Both mixed liquor pH and mixed liquor dissolved oxygen dropped immediately after feeding, a result of metal oxidation, and rose to normal after metal oxidation was complete. Settling characteristics of the mixed liquor were poor throughout the study, a result of sludge bulking (nonfilamentous) and deflocculation following feeding and hindered settling from high mixed liquor suspended solids concentrations (8,800 mg per liter). Poor settling, characteristic of the fill-and-draw system, results from the shock on the starved microbial population when high strength feed is suddenly added. (Cassar-FRC)
W83-01901

COST-EFFECTIVE PRETREATMENT PROGRAMS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W83-01903

ACTIVATED CARBON: SORPTION OF DOC FROM WASTEWATER,
Brown and Caldwell, Pasadena, CA.
F. S. Cannon, and P. V. Roberts.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 766-783, August, 1982. 6 Fig, 7 Tab, 29 Ref.

Descriptors: *Activated carbon, *Organic carbon, *Adsorption, Wastewater treatment, Effluents, Filtrasorb, Aquanuchar, Pores, Physical properties, Prune pit charcoal.

Activated carbons were prepared from prune pits by pyrolysis at 900 C from 15 to 60 min. These carbons were compared with commercial activated carbons with respect to specific surface area, pore volume distribution, and dissolved organic carbon (DOC) adsorption from filtered secondary wastewater effluent. Specific surface areas (sq m per g) were 663-1692 for prune pit char, 998 for Filtrasorb 400 (F400), 897 for Filtrasorb 100 (F100), and 810 for Aquanuchar A. Pore volumes (cu cm per g) were 0.363-0.930 for te prune pit char, 0.641 for F400, 0.596 for F100, and 0.596 for Aquanuchar. In the prune pit char the specific surface area and pore volumes increased with increasing activation time. Calculated partition coefficients were: F400, 56,700 g DOC adsorbed per g DOC in solution; prune pit charcoals, 18,300-94,900. Dissolved organic carbon uptake into powdered activated carbon behaved according to a model based on linear equilibrium and rate-controlled by pore diffusion. About 1 mg per liter (10%) of the DOC in the effluent was nonadsorbable by activated carbon regardless of dosage. Adsorbents F400 and the prune pit charcoal activated for 60 minutes behaved similarly in DOC adsorption. Apparent diffusion coefficients (times 10 to the minus 10th power sq m per sec) for DOC were 1.3 for F400 and 1.0, 1.6, and 2.9 for prune pit charcoals activated for 30, 42, and 60 minutes, respectively. (Cassar-FRC)
W83-01904

TREATMENT OF SALINE DOMESTIC WASTEWATER USING RBCS
New Hampshire Univ., Durham. Dept. of Civil Engineering.
N. E. Kinner, and P. L. Bishop.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, VOl 108, No EE4, p 650-664, August, 1982. 8 Fig, 3 Tab, 25 Ref.

Descriptors: *Saline water, *Biological wastewater treatment, Seawater, Wastewater treatment, Rotating biological contactors, Hydraulic loading, Biofilms, Islands, Appledore Island, New Hampshire.

Poor performance of a rotating biological contactor treating variably saline wastewater from a 100-person island treatment plant prompted a pilot scale evaluation of the process. Variation in salinity, from fresh water to 20,000 mg per liter salt, and changes in disk media (plastic or Masonite) produced no significant differences in effluent quality ($<$ 20 mg per liter BOD), which was adequate for discharge into marine or fresh receiving waters. Mean COD removals were 61% and 64% at hydraulic loading rates of 0.04 and 0.08 cu m per sq m per day, respectively. At higher loading rates (0.33 cu m per sq m per day) organic removal dropped to 10%. Results indicated that the treatment problems at the plant were not caused by high salinity wastewater. It was recommended that the present 47.4 sq m of substrate available for biofilm attachment be increased to 186-372 sq m, depending on the loading rate. The May to October operation of the facility also necessitates an annual acclimatization period. This could be shortened by starting the yearly operation with fresh water based sewage from a nearby municipal plant. (Cassar-FRC)
W83-01907

EVALUATION OF SLUDGE DEWATERING ALTERNATIVES AT A METALLURGICAL REFINERY,
Teledyne Wah Chang, Albany, OR.
W. A. Crocker.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1417-1424, October, 1982. 1 Fig, 9 Tab, 14 Ref.

Descriptors: *Sludge dewatering, *Activated sludge process, *Sludge disposal, Wastewater treatment, Waste disposal, Dewatering.

Experimental data and equipment design obtained from sludge dewatering pilot studies performed during the last half of 1978 are presented. Four different, commercially available machines were evaluated: a rotary-drum vacuum filter, a belt filter press, a recessed-plate filter press, and a solid bowl centrifuge. They were compared according to the following criteria: estimated capital cost for a complete dewatering system; delivery time for a properly designed machine; operating costs, including

power, chemicals, labor, maintenance, and disposal; and dryness of the wet cake and its suitability for hauling and disposal. The rotary drum vacuum filter and recessed plate filter press were eliminated from consideration because they exhibited low filtration rates. The belt filter press and the solid bowl centrifuge successfully dewatered the metal hydroxide sludge. The solid bowl centrifuge had lower estimated capital and operating costs, required less operator attention and maintenance, consumed less of the chemicals, and had a shorter delivery time. The belt filter press produced a much dryer cake, which would be substantially easier to handle, store and dispose of. The belt filter press generated much less sludge, significantly reducing storage requirements and hauling/disposal costs. (Baker-FRC)
W83-01933

SEASONAL TREATMENT AND VARIABLE EFFLUENT QUALITY BASED ON ASSIMILATIVE CAPACITY,
Stanley Consultants, Inc., Atlanta, GA.
For primary bibliographic entry see Field 6F.
W83-01935

STORMWATER POLLUTION CONTROL: STRUCTURAL MEASURES,
Santa Clara Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-01944

WASTEWATER TREATMENT IN SOIL AS A FUNCTION OF RESIDENCE TIME IN THE ROOT ZONE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
W. L. Magette, E. R. Collins, and V. O. Shanholtz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167536, Price codes: A05 in paper copy, A01 in microfiche. Virginia Water Resources Research Center Completion Report, Blacksburg, November 1982. 95 p, 14 Fig, 27 Tab, 36 Ref. OWRT A-088-VA(2).

Descriptors: *Land application, *Wastewater disposal, *Effluent irrigation, Land treatment design, *Nitrate pollution, Percolation, SPAW model, Soil water model, *Root zone, *Soil water movement, Simulation, Sandy loam.

A laboratory study was conducted in an effort to establish a relationship between residence time of land applied wastewater in the root zone and the degree to which nitrogen is removed from the wastewater. Each of sixteen soil samples of a Cecil gravelly sandy loam (Typic Hapludult; clayey, kaolinitic, thermic) was placed in an environmental chamber and seeded to tall fescue at the rate of 22.5 kg/ha. These samples simulated actual field conditions. Soil water (and wastewater) movement through the root zone under wet conditions (50-75% saturated) were described with the aid of a digital simulation model. A procedure was developed to predict the rate and volume of drainage as a function of initial soil moisture content, amount of liquid applied, and time after liquid application. An exact relationship between nitrogen removals and wastewater residence time in the root zone could not be developed. However, removals of up to 95% of applied NH4(+)(-)N were observed in an 18-cm deep root zone with residence times as short as 2 hours. Recommendations are made for future investigations, including types of soils and the use of more sophisticated monitoring equipment (such as dual gamma ray attenuation).
W83-01950

FLOC PROPERTY EFFECTS ON SLUDGE DEWATERING CHARACTERISTICS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W83-01957

NITRIFICATION RATES IN ACTIVATED SLUDGE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
J. H. Sherrard, D. K. Manning, and D. A. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers Vol 108, No EE5, p 1074-1078, October, 1982. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Nitrification, *Activated sludge process, *Stoichiometric analysis, Sludge, *Wastewater treatment, Nitrigen, Oxygen demand, Biomass.

A stoichiometric analysis was made of the nitrification process under steady-state conditions. Based on this study it was concluded that for a given wastewater, the nitrifier fraction is not a constant and is dependent on the mean cell residence time and the COD:TKN ratio. The percentage of nitrifiers present in an activated sludge biomass did not have an effect on the rate of nitrification. (Baker-FRC)
W83-01959

CONSIDERATIONS IN MODELING ACTIVATED SLUDGE PROCESS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
G. E. Speitel, Jr., and M. M. Hughes.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 990-1002, October, 1982. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Model studies, Sludge, Mathematical studies, *Design criteria, Water treatment facilities, Construction.

Mathematical modeling of the activated sludge process is examined both from a unit process viewpoint and as an integral component of plant-wide mass balance models. Two modeling approaches are reviewed. The first is a standard approach now commonly used in practice. The second is an alternative approach which represents a modification of the first to directly account for influent suspended solids to the activated sludge process. Considerations are presented as to the proper application of both models in the prediciton of waste sludge production and mixed liquor concentration. The two approaches also are compared for utility in wastewater treatment plant design. The alternative approach may be more flexible in accounting for sludge handling recycle loads. In many instances it also provides a more conservative estimate of waste sludge production. (Baker-FRC)
W83-01960

FACT SHEET FOR WASTEWATER TREATMENT,
D. V. Feliciano.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1346-1348, October, 1982. 5 Tab.

Descriptors: *Data collections, *Wastewater treatment, Construction, Grants, Municipal wastewater, Water treatment facilities, Nonpoint pollution sources, Pollution load.

A collection of various facts concerning water pollution control is presented to aid the researcher in preparing papers which may require some of this information. Facts are given concerning existing municipal wastewater treatment plants - including both performance and flow statistics; treated effluent discharges; year 2000 municipal wastewater treatment plants' performance and flow data; status of municipal treatment facilities; and the fiscal year breakdown of the construction grants program from 1973 through June of 1982. (Baker-FRC)
W83-01962

COMPARISON OF FINAL CLARIFIER DESIGN TECHNIQUES,
Greeley and Hansen, Chicago, IL.
T. E. Wilson, and J. S. Lee.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1376-1381, October, 1982. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Design criteria, *Clarifiers, *Wastewater treatment, Mathematical equations, Activated sludge process, Effluents, Sludge thickening, *Settling velocity.

The fundamental relationships and differences between the limiting flux theory and the initial settling velocity technique (SV) as used in the design of activated sludge final clarifiers are discussed. The approach taken in the study uses the mathematical technique developed to represent the limiting solids flux theory. The surface overflow rate, a clarifier design parameter, was calculated using both techniques for a mixed liquor having a relationship between the initial settling velocity and MLSS. The effect of the return ratio on the results was also investigated. A safety factor concept was established and used to modify the ISV technique. Two design examples were presented for the purpose of comparison. The results obtained provide a useful tool for the plant operator, who can use a single ISV test to determine whether or not his plant is flux limited at any given moment. (Baker-FRC)
W83-01963

OXYGEN ACTIVATED SLUDGE DESIGN FOR INDUSTRIAL AND MUNICIPAL WASTES,
Black and Veatch, Kansas City, MO. Process Control Dept.
J. R. Stukenberg.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1382-1387, October, 1982. 3 Fig, 4 Tab, 4 Ref.

Descriptors: *Activated sludge process, *Design criteria, *Wastewater treatment, Mathematical equations, Sludge, *Oxygen, Municipal wastes, Water treatment facilities, Missouri, Kansas City.

The process design for the liquid phase of the expanded treatment plant, particularly the HPOAS system, is described. Information is presented relating the use of conventional complete mixing activated sludge mathematics to the high purity oxygen activated sludge system. Specification for performance testing of the oxygenation equipment is also discussed. The process design dealt with the strength and variability of the waste as well as the nutrient deficiency of the waste. Using complete mixing activated sludge (CMAS) mathematics and oxygen transfer relationships, it was possible to determine the aeration basin detention time, the quantity of oxygen to be transferred to the wastewater and the power requirements for dissolution of the oxygen. It was possible using equipment manufacturer input to determine the capacity of the oxygen generating equipment and the parameters needed for specification and testing of the surface aeration equipment. (Baker-FRC)
W83-01964

PARTICLE BEHAVIOR IN GRAVITY THICKENING,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. F. Lawler, P. C. Singer, and C. R. O'Melia.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1388-1400, October, 1982. 6 Fig, 7 Tab, 28 Ref.

Descriptors: *Sludge thickening, *Design criteria, *Activated sludge process, *Wastewater treatment, Sludge, Sludge dewatering, Particle behavior.

Particle behavior was studied in the thickening of slurries with heterodisperse particle sizes. Evidence is presented, based on particle size distribution measurements, that coagulation and differential sedimentation occur during batch thickening. These phenomena that occur at the microscopic level influence macroscopic settling behavior. The extent to which these phenomena occur is shown to be dependent on the initial particle size distribution, surface characteristics of the particle, and concentration. The implications of these findings for research to understand the thickening theory as to the design and operation of continuous thickeners were considered. (Baker-FC)
W83-01965

REALISTIC SLUDGE PRODUCTION FOR ACTIVATED SLUDGE PLANTS WITHOUT PRIMARY CLARIFIERS,
M and I, Inc., Fort Collins, CO.
J. R. Schultz, B. A. Hegg, and K. L. Rakness.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1355-1360, October, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Sludge, *Activated sludge processes, Clarifiers, Effluent, Water pollution control, *Water treatment facilities.

Nearly 200 wastewater treatment plants were evaluated to determine plant operability and define plant performance-limiting factors. Actual sludge production data were presented for 16 well operated activated sludge plants without primary clarifiers. The average sludge production coefficient for all plants was 0.86 kg TSS/kg BOD-R. Of this total, only 10% was discharged in the plant effluent. Sludge production and wasting requirements varied considerably both between plants and also within a single plant for different periods. Cell yield coefficients that address only biological solids growth should not be used as estimates of total sludge production. Design of sludge handling facilities should include capabilities to handle sludge wasting at levels of at least 150% of design for several months. Adequate sludge handling facilities can contribute significantly to achieving and maintaining a high quality effluent from small activated sludge plants without primary clarifiers. (Baker-FRC)
W83-01966

RELATION OF INFLOW/INFILTRATION COSTS TO VARYING POLICY REQUIREMENTS,
National Semiconductor Corp., Santa Clara, CA.
For primary bibliographic entry see Field 5G.
W83-01969

IN SITU STUDIES WITH MEMBRANE DIFFUSION CHAMBERS OF ANTIBIOTIC RESISTANCE TRANSFER IN ESCHERICHIA COLI,
California Univ., Davis. Dept. of Genetics.
M. R. Altherr, and K. L. Kasweck.
Applied and Environmental Microbiology, Vol 44, No 4, p 838-843, October, 1982. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Escherichia coli, *Sewage bacteria, *Wastewater treatment, *Coliforms, *Membrane processes, *Resistance, Bacteria, Enteric bacteria, Wastewater pollution, Effluents.

The ability to transfer antibiotic resistance to Escherichia coli K012 C600 was examined in coliform bacteria isolated from raw sewage and sewage effluent-receiving waters. An environmental isolate of E. coli (MA527) capable of transferring antibiotic resitance to C600 was mated, both in vitro and in situ, with an antibiotic-sensitive E. coli environmental isolate (MA728). In situ matings were carried out in modified membrane diffusion chambers in the degritter tank at the Grant Street (Melbourne, Florida) sewage treatment plant and in sewage effluent-receiving waters in Melbourne, Florida. Higher transfer frequencies were observed in virto than in situ. Transfer was presumed to have occurred if lactose-negative colonies grew after 24 to 48 hr of incubation at 37 degrees on double inhibitor-supplemented Mac Conkey agar. Transfer was observed in raw sewage but not in effluent-receiving waters. The transfer of antibiotic resistance in situ was ascertained by the presence of a 60-megadalton plasmid species in both donor and transconjugants. (Geiger-FRC)
W83-01996

COMPUTER ANALYSIS OF SETTLING TEST DATA,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthoux, and D. K. Stevens.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 1065-1069, October, 1982. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Computers, *Analysis, *Settling, *Flocculation, Sedimentation, Suspended solids, Fate of pollutants, Chemical coagulation, Dispersion, *Wastewater treatment.

A method of analyzing test data is presented which can serve for either discrete or flocculant settling. The method is based on fitting a simple approximating polynomial to the test data and using the fitted function for calculations. The method is simple, and is easily implemented. It is the mathematical equivalent of physically using a French curve to derive a simple, smooth function from the data. It can be used with the data as either concentrations or percentages. The use of concentration data is illustrated. (Baker-FRC)
W83-02035

WASTEWATER REUSE ENHANCEMENT BY USE OF IMMOBILIZED CHELATORS,
Bjorksten Research Labs., Inc., Madison, WI.
R. U. Schenk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167841, Price codes: A03 in paper copy, A01 in microfiche. Office of Water Research and Technology, Focused Research Series OWRT/RU-82-9, January 28, 1982. 34 p, 7 Fig, 13 Ref. OWRT C-00168-R(0527)(1), 14-34-0001-0527.

Descriptors: *Chelating agents, *Wastewater renovation, *Cadmium, *Industrial wastewaters, Wastewater treatment, Heavy metals, Water reuse, Electroplating, Metal-finishing wastes, Resins.

Heavy metal ion contamination of industrial wastewaters seriously reduces the reuse capabilities of the water. Two commercially available chelating resins and a laboratory synthesized experimental resin were tested in the laboratory for removal of toxic heavy metal ions and subsequent extraction and recycling. Cadmium was selected for primary study because of its high toxicity and current environmental concerns. Cadmium was extracted from industrial wastewaters both in the laboratory and in an electroplating plant. Cadmium levels of 0.01 ppm or less were obtained in treating the effluent of the acid sulfate plating wastewaters in the pilot sized plant test. Removal by the resin, extraction from the resin and subsequent recycling of the cadmium were found to be practical with the commercial resins, Cellulex UR and Chelex-100. The cellulose derived carbonyl sulfonate experimental resin was found to have essentially no capacity for cadmium extraction, so it appears to have little potential for being developed as a resin to be incorporated in an extraction belt. The continuous belt extractor tested lowered the cadmium level of the solution substantially. However, the retained solution on the belt caused appreciable spreading of the cadmium, not only into the acid bath but also into the rinse solutions. A wringer to press out the entrained water would appear to be necessary to achieve an effective process. (Moore-SRC)
W83-02054

LONG-TERM CAPACITY FOR ORGANIC-SUBSTRATE REMOVAL BY BACTERIAL FILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and C. W. Brunner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167999, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center Research Report No 172, University of Illinois, Urbana-Champaign, October 1982. 53 p, 21 Fig, 3 Tab, 20 Ref. OWRT A-108-ILL(1), 14-34-0001-1115.

Descriptors: *Biodegradation, *Biofilms, *Kinetics, *Mathematical modeling, *Trace organics, Model studies, *Wastewater treatment, Organic wastes.

When wastewater is discharged to small streams, the effluent quality normally obtained from a sewage treatment plant is often not good enough to prevent serious water-quality deterioration. Hence, enhanced removal of organic pollutants is required. Efficient and economic removal of organics to very low concentrations is best achieved by biofilm processes, in which bacteria are attached to a fixed media and remove the organic compounds from the wastewater flowing past. Laboratory-scale reactors were utilized to evaluate the ability of biofilms to remove low levels of organic contaminants in water during extended operation. Nonsteady-state operation, in which trace concentrations of organic substrate were treated with a biofilm previously grown on a relatively high concentration feed, demonstrated that a slowly decaying biofilm was able to bring about high efficiency removal of the trace compound for extended periods, up to 7 months in this study. A Kinetic model to describe the transient growth and decay of the biolfim was developed, and it predicted the growth and steady-state phases of the biofilm when input parameters were detemined independently. The observed slow decay rate of the biofilm prolonged the usefulness of the nonsteady-state biofilm and was explained by adaptation to oligotrophic (low concentration) conditions and the growth of nitrifying bacteria which produced supplemental organic substrate to sustain the organic-utilizing bacteria. The results of this study demonstrated that nonsteady-stable-biofilm processes can sustainably achieve organic concentrations much lower than conventional wastewater treatment.
W83-02069

SUBSTRATE REMOVAL AND SLUDGE PRODUCTION IN A BATCH ACTIVATED-SLUDGE PROCESS WITH BLENDING,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste, and J. K. Bewtra.
Canadian Journal of Civil Engineering, Vol 9, No 3, p 558-566, 1982. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Activated sludge process, *Mixing, *Wastewater treatment, Sludge, Chemical oxygen demand, Suspended solids, Oxygen uptake, Flocculation, Settleability.

The effect of mechanical blending of mixed liquor from the aeration chamber on the performance of both phases of the activated sludge process was investigated. Bench-scale studies were conducted in which the mixed liquor was blended periodically in an Osterizer blender. A similar unit without mechanical blending was operated as a control. Synthetic organic feed of known characteristics was used as substrate. Tests were conducted for mixed liquor volatile suspended solids (MLVSS), effluent chemical oxygen demand (COD), settleability, and oxygen uptake rate under steady-state conditions. Substrate uptake in both units was observed to be a rapid adsorption-absorption phenomenon. The nonremovable COD was significantly lower in the blended unit. Also, the oxygen uptake rates showed significant increases due to floc breakup. Settleability was good in the blended unit, and the overall effluent quality had improved considerably. (Baker-FRC)
W83-02080

TEMPERATURE EFFECT ON THE ANAEROBIC TREATMENT OF POTATO-PROCESSING WASTEWATER,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
K. C. Lin, R. C. Landine, and S. Bliss.
Canadian Journal of Civil Engineering, Vol 9, No 3, p 549-557, 1982. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Temperature effects, *Anaerobic digestion, Anaerobic lagoons, Aerated lagoons, Chemical oxygen demand, Suspended solids, Filters, Food processing wastes, Food processing industry, *Potato-processing wastes.

An attempt was made to determine the efficiency of an anaerobic lagoon-filter model in treating a potato-processing effluent at temperatures below 20C. The waste was unsettled primary clarifier influent from a food processing plant. Removals of chemical oxygen demand, suspended solids, as well

as sludge buildup in the lagoon and gas production were examined. The system, buffered with lime, was fed continuously. Detention times were 7.0 and 1.5 days for the lagoon and filter, respectively. The loading rate was 0.35 kg COD/(cubic m/day), based on lagoon volume. There was 100% recycling but no sludge wastage. Between 10 and 20C the system removed about 94% of the COD and 95% of the SS. Down to 4C removals of 85% COD and 93% SS were obtained. At 2C system failure was imminent. The sludge accumulation rate was highest at 6C, four times the rate at 20C. Total methane production varied from 0.35 cubic m/kg COD removed at 20C down to 0.24 cubic m/kg COD removed at 4C, with a 62% decrease in volumetric rate. Methane content in the gas was 75-84%. The filter had a higher methane production-to-COD removal ratio and a higher methane content than the lagoon. (Baker-FRC)
W83-02081

5E. Ultimate Disposal Of Wastes

COMPOSITION AND DEWATERING PROPERTIES OF BIOLOGICAL SLUDGES,
Missouri Univ.-Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-01792

SECURING AN ABANDONED HAZARDOUS WASTES SITE,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
W. V. Blasland, Jr., W. H. Bouck, E. R. Lynch, and R. K. Goldman.
Industrial Wastes, Vol 28, No 5, p 19-22, September/October, 1982. 4 Fig.

Descriptors: *Hazardous wastes, *Land disposal, *Dumping, Waste disposal, Vegetation, Plant growth, Vegetation establishment, Revegetation, Fort Miller, *New York, Industrial wastes, Municipal wastes.

The General Electric Company and the New York State Department of Environmental Conservation signed a major agreement in which a corporation agreed to pay for remedial action to clean up abandoned hazardous waste dump sites at seven locations. One of the sites in the agreement was Fort Miller, located about 7.5 miles south of Hudson Falls, New York. This site was an open municipal/industrial dump operating as a burning dump between 1953 and 1965. Field studies indicated that there were two groundwater zones at the site, a shallow perched zone at the clay/refuse interface and a permanent one at a depth of 3 to 20 feet below grade. The recommended remedial program is in-place containment of wastes, to include a clay cap with vegetative cover, a relocated surface drainage system, a leachate collection system and a gas venting system. At present all surface runoff is collected in a series of drainage channels along the toe of the site. The fill placed during regrading operations will cover the existing channels, and new channels will be built. Since the impermeable cap over the site will eliminate percolation of surface water into the refuse, the source of additional leachate will be removed, and the existing leachate should be collected and disposed of within an estimated six months to one year following cap installation. (Baker-FRC)
W83-01811

LYSIMETERS FOR SIMULATING SANITARY LANDFILLS,
Technische Univ., Brunswick (Germany, F.R.). Leichtweiss Inst. for Water Research.
H-J. Collins, and P. Spillmann.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 852-863, October, 1982. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Lysimeters, *Landfills, Waste disposal, *Leaching, Percolation, Leachate.

Various decomposition processes inside sanitary landfills are being studied. Eight different modes of operation of sanitary landfills will be simulated by special lysimeters during the course of the study. These lysimeters consist of flexible walls, which allow settlements similar to that to nature to occur. Thermal insulation of the lysimeter protects the biological and chemical processes against outside temperatures. The leachate is collected separately from different compartments in the base, and samples of seepage are drawn from different levels. The lysimeters allow taking samples of refuse or the inserting of material at different places and levels. The density of the refuse in the lysimeter filled according to today's practice is in the range usually encountered in practice, while mixing of the refuse or refuse and sludge increases the density considerably. After aerobic decomposing, sieving, and compacting, the required deposition volume was one-third compared to the present common practice. After five years of study it was noted that leachate forms before the material is saturated. As a consequence of this and by interpreting the accumulated outflow of the lysimeter it can be stated that the quantity of outflow will increase after the operation of a sanitary landfill has ended. (Baker-FRC)
W83-01908

SLUDGE UTILIZATION AND DISPOSAL IN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
D. C. Martens, G. D. McCart, R. B. Reneau, Jr., T. W. Simpson, and T. Ban-Kiat.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167510 , Price codes: A06 in paper copy, A01 in microfiche.
Virginia Water Resources Research Center Completion Report, Blacksburg, October 1982. 107 p, 14 Tab, 209 Ref. OWRT A-097-VA(1).

Descriptors: *Sewage Sludge, *Land Application, *Sludge Disposal, Wastewater Treatment, *Sludge Treatment, Sewage Treatment plants, Agronomy, Agriculture, Fertilizers, Nitrogen, Phosphorus, *Virginia, Literature reviews, Research needs, Research priorities.

This state-of-the-art study was initiated to determine the problem issues, present knowledge about the issues, and additional research needs in the area of land disposal of municipal sewage sludge. Three questionaires were developed to survey technically oriented professional, county extension agents, and Virginia NPDES permit holders to obtain these groups' views on problems and deficiencies needing further investigation. Another phase of the study was to conduct an extensive review of the literature on the subject of land application of sewage sludge. Listings of pertinent literature relating to land application with specific interest toward potentially toxic metals, pathogens, nitrogen, and phosphorus were obtained and reviewed. Additional research is needed in the following areas: a method that accurately estimates metal availability within the soil; a method to determine the potential for a disease outbreak from controlled application of treated municipal sewage sludge; a more precise method of N-balancing; the impact of P loading on water quality.
W83-01948

FLOC PROPERTY EFFECTS ON SLUDGE DEWATERING CHARACTERISTICS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and D. L. Wakeland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167601, Price codes: A04 in paper copy, A01 in microfiche.
Virginia Water Resources Center Bulletin 133, Blacksburg, December 1982. 72 p, 21 Fig, 4 Tab, 32 Ref. OWRT A-091-VA(1).

Descriptors: *Sludge floc, *Sludge dewatering, *Sludge handling, *Floc density, Sludge filtrate viscosity, Floc compressibility, Floc strength, Particle size distribution, *Sludge disposal, Biopolymer content, *Sludge treatment, Virginia, Filtration.

The technical and economic problems associated with sludge handling and disposal have increased in recent years because of (1) the introduction of more strigent water and air pollution regulations and (2) the development of regulations that stipulate the means of ultimate disposal of sludge residues. These regulations have resulted in the need to produce sludges with both good dewatering characteristics and low water content to minimize the ultimate volume of solids that require disposal. The objective of this study was thus to examine the fundamental parameters that affect sludge dewatering characteristics. Included are analyses of both sludge dewatering and sludge handling characteristics. Parameters include floc size shape and density; sludge viscosity and shear strength; and floc compressibility. Both water and wastewater sludge samples were collected from full-scale treatment plants in Virginia and were analyzed for each of the above-mentioned parameters. They were then subjected to dewatering studies using laboratory-scale vacuum filtration, sandbed, and filter press equipment. Sludge handleability was evaluated through the standard Atterburg liquid limit test procedure. Three main conclusions can be drawn from this study: (1) Particle size distribution is a key parameter for describing the response of sludges to each of the dewatering methods used, although other factors, such as biopolymer content, apparently have a major effect on the dewatering characteristics of biological sludges. (2) Sludge floc density has a direct correlation to the ultimate solids concentration obtained by vacuum filtration. (3) The use of high-pressure filtration provides more appropriate information on water content than the centrifugation method.
W83-01957

CURRENT MUNICIPAL SLUDGE UTILIZATION AND DISPOSAL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
J. J. Peirce, and S. Bailey.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 1070-1073, October, 1982. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Waste disposal, *Sludge disposal, *Sludge utilization, Municipal wastes, Data collections, Wastewater treatment, Surveys.

An overview is presented of the research and results of an inventory being made on municipal sludge utilization and disposal practices. Data collection activites included telephone interviews to identify key individuals and corresponding addresses within the Public Owned Treatment Works (POTW) service area, followed by the mail-out of data collection sheets and subsequent lengthy telephone interviews to transmit data collected on site. In all, 1,008 POTW's were contacted and 2,299,729 dry metric tons per day of sludge were accounted for . Seven basic technologies are adopted for sludge utilization and disposal. To varying degrees, seven basic sludge disposal methods are used across the nation. Sixty-four percent of all POTW's relied on a single method sludge disposal. Distribution and marketing was practiced widely, but was not relied upon as the major disposal method for most POTW's. About 80% of the distribution and marketing of these POTW's uses two more disposal options. Disposal and marketing is not generally relied upon as the critical disposal technology in the sludge disposal plans at most POTW's. (Baker-FRC)
W83-01958

PARTICLE BEHAVIOR IN GRAVITY THICKENING,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-01965

CHEMICAL PROPERTIES AND MINERALOGICAL CHARACTERISTICS OF SELECTED DREDGED MATERIAL,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W83-01970

MONITORING OF A MUNICIPAL SLUDGE ENTRENCHMENT SITE,
Agricultural Research Service, Beltsville, MD. Biological Waste Management and Organic Resources Lab.
For primary bibliographic entry see Field 5B.
W83-01972

WATER REGIME AND NITROGEN FERTILIZATION FOR RHODES GRASS IRRIGATED WITH MUNICIPAL WASTE WATER ON SAND DUNE SOIL,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
I. Vaisman, J. Shalhevet, T. Kipnis, and A. Feigin.
Journal of Environmental Quality, Vol 11, No 2, p 230-232, April-June, 1982. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Wastewater irrigation, *Nitrogen removal, *Crop yield, Optimal yield, Fertilizers, Municipal wastewater, *Wastewater disposal, *Land disposal, Groundwater pollution, Water supply, Soil profiles.

Irrigating crops with treated municipal wastewater can increase the water supply and reduce the need for fertilizer. However, the water and fertilizer needs of the particular crops must be known in order to minimize water loss and the potential for groundwater pollution. The water requirements and fertilizer needs of Rhodes grass (Chloris gayana Kunth), a high-yielding perennial forage crop, were investigated in field experiments on a sand dune soil during 1978 and 1979. The grass was irrigated with municipal effluent that had received secondary treatment in settling ponds. Four sprinkler irrigation regimes were used, each at two levels of additional nitrogen fertilizer. The wastewater effluent contained about 18 milligrams of nitrogen per liter, which did not supply the full needs of the crop. The addition of 250 kilograms of nitrogen per hectare as ammonium sulfate ((NH4)2SO4) resulted in an optimum dry matter yield of 12.0 metric tons per hectare when irrigation was applied on the basis of a Class A pan evaporation factor of 0.8. Very little or no deep seepage occurred with this treatment, while higher rates of effluent application resulted in the soil profile remaining wet below a depth of 60 centimeters. Greater nitrogen application levels resulted in the loss of nitrogen in the drainage water from the plots. The Rhodes grass proved to be an efficient remover of nitrogen from the effluent, preventing both deep seepage and groundwater pollution when the irrigation water was applied at appropriate levels. (Carroll-FRC)
W83-01975

AMMONIA-OXIDIZING BACTERIA POPULATIONS AND ACTIVITIES IN SOILS IRRIGATED WITH MUNICIPAL WASTE WATER EFFLUENT,
Kimberly-Clark Corp., Neenah, WI.
K. M. Chopp, C. E. Clapp, and E. L. Schmidt.
Journal of Environmental Quality, Vol 11, No 2, p 221-226, April-June, 1982. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Municipal wastewater, *Bacteria, *Land disposal, *Soil bacteria, Nitrification, Irrigation, Soil water, Nitrates, *Wastewater disposal, Wastewater irrigation, Population dynamics, Biological oxidation, *Minnesota, *Ammonia-oxidizing bacteria.

Properly managed application of treated municipal wastewater effluents to agricultural land may provide nutrients and water to crops and recharge groundwater supplies without adverse environmental effects. The effects of effluent treatment on the populations and activities of ammonia-oxidizing bacteria in the treated soil were investigated during one corn growing season in Minnesota. Fluorescent antibody techniques were used to enumerate soil populations of one serotype each of the ammonia-oxidizing genera Nitrosomonas, Nitrosolobus, and Nitrosospira. Populations of these three bacteria fluctuated only slightly over the entire growing season. Each genus peaked at a separate time. Higher effluent treatments resulted in slightly smaller populations of these bacteria than either fertilized control or low effluent treatments. Ammonia oxidation activity was significantly higher for soils receiving higher rates of effluent. Soil nitrogen levels showed sharp decreases in ammonium nitrogen when the population of ammonia-oxidizing bacteria peaked in June, but began to accumulate in the fall when these populations declined. Both effluent treatment and time significantly affected the concentration of nitrate-nitrogen in the soil. Nitrate-nitrogen concentrations in soil water and groundwater varied with effluent treatment and time, with the peak concentrations occurring about 1 month after the peak N03-N concentrations in the soil. (Carroll-FRC)
W83-01976

PREDICTED SOLUTION PHASE FORMS OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
W. E. Emmerich, L. J. Lund, A. L. Page, and A. C. Chang.
Journal of Environmental Quality, Vol 11, No 2, p 182-186, April-June, 1982. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Heavy metals, *Sludge disposal, *Soil solution, Soil columns, Solutes, Cadmium, Copper, Nickel, Zinc, *Land application, Chemical properties, *Computer programs, Soil profiles, *GEOCHEM computer program.

The chemical forms of heavy metals in soil solutions can significantly affect the movement of those metals through the soil matrix. Total metal concentrations were determined in the soil solutions of soil columns treated with sewage sludge and leached over a 25 month period. The GEOCHEM computer program was used to evaluate the chemical forms of cadmium, copper, nickel, and zinc in the soil solutions and to determine the changes with depth in the chemical forms of these metals in the soil solutions. Although the total concentrations of the four heavy metals in the soil solutions were elevated by the sewage sludge additions, in most cases they were still within ranges found in survey of untreated soils. The metal concentrations in the soil solutions were so low that they made only a negligible contribution to metal movement during the course of the study. Data on metal complexes in the soil solutions were used to group the metals into free ionic and organic and inorganic complexed forms. Between 50 and 60 percent of the cadmium, 50 and 70 percent of the nickel, and 60 and 70 percent of the zinc in solution was found to be in the free ionic form. Copper was almost exclusively in organically complexed forms in the sludge soil layers and shifted somewhat to free ionic form with decreasing pH at greater depths below the sludge incorporation layer. In all cases, the metal concentrations in the soil solution for the sludge incorporation layer were significantly higher than those below the sludge soil interface. The addition of sewage sludge to the soils increased the activity of the metals in the soil solution of the sludge incorporation layer. The metals in soil solutions were generally undersaturated, at least with respect to the soluble mineral phases studied, and the solid phase that is controlling the metal activity is not known. (Carroll-FRC)
W83-01977

SOLID PHASE FORMS OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
W. E. Emmerich, L. J. Lund, A. L. Page, and A. C. Chang.
Journal of Environmental Quality, Vol 11, No 2, p 178-181, April-June, 1982. 5 Tab, 6 Ref.

Descriptors: *Heavy metals, *Soil columns, *Sludge disposal, *Land application, Digested sludge, Cadmium, Copper, Nickel, Zinc, Solids, Chemical properties.

Heavy metals in the solid phase of soils or sewage sludge treated soils occur in many chemical forms, and the form taken can greatly influence the fate of the metal in terms of plant uptake or soil profile migration. The solid phase chemical forms of cadmium, copper, nickel, and zinc in sludge soil mixtures which had been subjected to long-term incubation and leaching were investigated using a sequential extraction procedure. The applied sewage sludge, untreated soil samples, and treated soil samples were fractionated into the designated forms of exchangeable, adsorbed, organically bound, carbonated, and residual. The metals added to the soil had not moved out of the sludge-soil incorporation layers during 25 months of leaching. A comparison of the chemical forms of the metals present in the sludge-soil layers at the termination of the leaching process with those initially present in the sewage sludge and in the soil showed that cadmium, nickel, and zinc were all shifting to the residual form, while the form of the copper (mostly organically bound) did not change significantly during the study. The occurence of metals in the stable organically bound, carbonate, and residual forms in the sludge, coupled with a shift toward the more stable form after soil incorporation, contributed to the lack of metal movement found in the soil profiles. (Carroll-FRC)
W83-01978

MOVEMENT OF HEAVY METALS IN SEWAGE SLUDGE-TREATED SOILS,
Agricultural Research Service, Tucson, AZ.
For primary bibliographic entry see Field 5B.
W83-01980

DISPOSAL OF FEEDLOT LAGOON WATER BY IRRIGATING BROMEGRASS: I. CROP REMOVAL OF NITROGEN,
Kansas Agricultural Experiment Station, Manhattan. Dept. of Agronomy.
R. V. Olson, R. V. Terry, W. L. Powers, and C. W. Swallow.
Journal of Environmental Quality, Vol 11, No 2, p 267-272, April-June, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Nitrogen removal, *Wastewater irrigation, *Bromegrass, Crop yield, Land disposal, Feedlot wastes, Wastewater lagoons, Performance evaluation.

Nitrogen removal efficiency is an area of considerable concern when using soils and crops as agents for the disposal of waste waters from feedlots and municipal sewage plants. The effectiveness of bromeglass (Bromus inermis) in removing nitrogen from beef feedlot lagoon water was investigated in field plots irrigated at four rates in three replications over a 4 year period. Microplots within the main plots for two treatments received lagoon water enriched with nitrogen-15. Bromegrass was harvested two or three times each year, with yields and total nitrogen uptake determined for the main plots and yields, total nitrogen uptake, and lagoon water nitrogen uptake determined for the microplots. Although yields and total nitrogen uptake increased with irrigation rates, the excessive moisture on the stands of grass resulted in decreases in yields and total nitrogen uptake with time. When stands were maintained through reseeding, yields increased with time. Applications of 2.5 and 5.1 centimeters of lagoon water resulted in the removal of more total nitrogen than was applied, but higher irrigation levels resulted in the removal of less total nitrogen than that applied. The highest irrigation rate (10.2 centimeters) resulted in 1.8 times more uptake of lagoon water nitrogen than the 5.1 centimeter treatment. Although the percentage of lagoon water nitrogen removed increased with time, it appeared to be leveling off at about 40% after 4 years. Bromegrass is not the best crop to use for removal of nitrogen from lagoon water, since excessive moisture results in reduction of stands of this crop. Low rates of application of lagoon water provide more satisfactory results, since they leave less lagoon water nitrogen in the soil than high irrigation rates and result in the uptake of more total nitrogen than that present in the applied wastewater. (Carroll-FRC)
W83-01981

ADSORPTION OF REOVIRUS BY MINERALS AND SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W83-01995

5F. Water Treatment and Quality Alteration

THE INFLUENCE OF FILTER GRAIN STRUCTURE ON THE BEHAVIOR OF DEEP BED FILTERS (EINFLUSS DER FILTERKORNSTRUKTUR AUF DAS VERHALTEN VON TIEFENFILTERN),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5D.
W83-01752

DETERMINATION OF MUTAGENIC ACTIVITY IN SALMONELLA OF RESIDUAL FULVIC ACIDS AFTER OZONATION,
Department of National Health and Welfare, Ottawa (Ontario). Environmental and Occupational Toxicology Div.
D. J. Koowbel, E. R. Nestmann, M. Malaiyandi, and R. Helleur.
Water Research, Vol 16, No 11, p 1537-1538, November 1982, 1 Tab, 13 Ref.

Descriptors: *Ozonation, *Water treatment, *Fulvic acids, *Water reuse, *Podzols, *Assay, Salmonella, Ozone, Chlorination, Chlorine, Chloroform, Humic acids, Recycling, Prince Edward Island, Canada, Ames assay.

The mutagenic potential of residual products derived from ozonation of fulvic acids was studied in ozonated soil and water samples using the Ames Salmonella/mammalian microsome assay. Soil fulvic acid was extracted from a Bh horizon podzol soil from Prince Edward Island, Canada, while water fulvic acid was isolated from a shallow pond in Parkland near Ottawa. Results of the mutagenicity tests showed that all but one sample of ozonated residues of fulvic acid was negative in the standard Salmonella plate tests using 5 bacterial strains. A highly ozonated soil fulvic acid extract showed a 1.8-fold increase over background mutagenicity levels in strain TA100 only and did not require microsomal activation for the weak mutagenic response observed. The implications of these findings on the treatment of recycled water for potable uses are discussed. (Geiger-FRC)
W83-01757

AEROBIC AND ANAEROBIC MICROORGANISMS IN TUBERCLES OF THE COLUMBUS, OHIO, WATER DISTRIBUTION SYSTEM,
Ohio State Univ., Columbus. Dept. of Microbiology.
O. H. Tuovinen, and J. C. Hsu.
Applied and Environmental Microbiology, Vol 44, No 3, p 761-764, September 1982, 3 Tab, 10 Ref.

Descriptors: *Water distribution, *Pipelines, *Bacteria, *Public health, Columbus, *Ohio, Water quality, Water conveyance, Drinking water, Water supply, Corrosion, Disinfection, Chlorine, *Microorganisms, *Tubercles, Ion compounds.

Aerobic and anaerobic microorganisms were counted in tubercles collected from sections of the water distribution pipeline in Columbus, Ohio, metropolitan area. Coliform bacteria were not detected in the tubercles examined. Sulfate-reducing bacteria were detected in 80% of the samples. Nitrate-reducing heterotrophs were present in all samples. The findings, including plate counts of aerobic heterotrophs, indicated variation in bacterial densities depending on the tubercle sample and fraction examined. The associations among the viable counts obtained by the different culture methods were statistically analyzed. The high counts of different bacterial groups suggest that there are zones in the tubercle mass that contain enough organic compounds and other nutrients to support the development of various types of microorganisms. Microcosms may exist in which symbiotic relationships such as nutrient cycling contribute to high numbers of diverse organisms. (Baker-FRC)
W83-01770

PUBLIC WATER SUPPLY QUALITY IN THE ROCK RIVER WATERSHED, SOUTHWEST MINNESOTA,
Minnesota Univ., Minneapolis. School of Public Health.
C. P. Straub, V. M. Goppers, and R. D. Singer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-154369, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, Bulletin 110, University of Minnesota, St. Paul, October 1982. 54 p, 29 Fig, 1 Tab, 11 Ref. OWRT A-038-MINN(2).

Descriptors: *Minnesota, Water quality, *Municipal water supplies, Groundwater quality, Public health, Surface water quality, Anions, *Rock River watershed, Seasonal changes, *Drinking water standards.

Several municipal water supplies in the Rock River watershed in Southwestern Minnesota were tested on approximately a monthly basis for a little over two-years for the anions nitrate-nitrogen, sulfate, chloride, and bicarbonate alkalinity as calcium carbonate, and for total dissolved solids, conductivity, and pH. Anions were selected for analysis because it was felt that they were better descriptors of the effect of land use practices on ground water quality. The ratios of the various anions sulfate-nitrate-nitrogen, chloride/nitrate-nitrogen, sulfate-chloride, and bicarbonate alkalinity as calcium carbonate-sulfate served to identify changes in water quality not associated with dilution. Findings indicated seasonal changes in water quality not necessarily reflected in changes in the ratios, generally increasing concentrations of nitrate-nitrogen in many instances, exceeding permissible concentrations specified in the Interim Primary Drinking Water Standards, and high dissolved solids concentrations generally exceeding recommended levels specified in the Secondary Drinking Water Standards. Ground water concentrations were compared with surface water samples from the several streams, springs, and lakes in the area. Some relations to land use practice on ground water quality and precipitation were indicated. The data have been utilized to call attention to deficiencies in water quality to the consumers of the waters in the communities concerned.
W83-01790

COMPARATIVE STUDIES ON THE EFFICIENCY OF VARIOUS BACKWASH SYSTEMS IN GRANULAR FILTRATION PLANTS (VERGLEICHENDE UNTERSUCHUNGEN UBER DIE WIRKSAMKEIT VON VERSHIEDENEN RUCKSPULSYSTEMEN BEI KORNMASSENFILTERN),
WABAG G.m.b.H. and Co. KG, Kulmbach (Germany, F.R.).
W. Kretzschmar.
Gas-Wasserfach Wasser-Abwasser, Vol 123, No 5, p 229-234, May 1982. 9 Fig. English summary.

Descriptors: *Gravity filters, *Backwash, *Bank washing, *Continuous flow washing, *Water treatment, Filters, Costs, Construction costs, Sludge, Filtration.

Rapid gravity filters, usually constructed from concrete, have been used successfully in water treatment for many years. Their advantages include efficient use of available surface, resistance to corrosion, and adaptability. Two backwash systems, bank washing and continuous flow washing, came into use with the introduction of multimedia filters. These systems were tested by an extensive series of experiments for their efficiency, i.e., the ratio of pollutants extracted to the amount of backwash water consumed. The experiments revealed that the two systems did not differ in water consumption or sludge water volume, though there were differences in pollutant extraction at certain backwash speeds. Construction costs were generally similar, though continuous flow systems using new construction techniques were the most economical. Before deciding upon a backwash system, the purpose of the filter should be defined, and consideration should be taken of whether it will be single or multimedia, whether reaction space is required, the hydraulic influence of the filter matter, intensity of sludge formation, backwash speed, and integration into an existing hydraulic system. (Gish-FRC)
W83-01805

WATER PLANT EXPANSION SUCCESSFULLY COMBINES THE OLD AND THE NEW,
P. R. Boller.
Public Works, Vol 113, No 10, p 37-39, October, 1982.

Descriptors: *Construction, *Expansion, *Water treatment, Three Rivers Treatment Plant, Aesthetics, Ft. Wayne, *Indiana, St. Joseph River.

The Three Rivers Water Treatment Plant, Fort Wayne, Indiana, was expanded to 72 mgd average (90 mdg maximum) in 1981. The plant now consists of three treatment facilities operating in parallel. Originally built in 1934 (capacity 24 mgd) and increased to 48 mgd in the 1950's, the plant uses St. Joseph River water as the raw water source. The most recent addition retained the character of the original structure, noted for its Gothic architecture and stone carvings. Energy conservation and operating efficiency were incorporated into the plant expansion, in particular, horizontal, turbine-type mixers in the flocculation chambers, a liquid carbon dioxide system for recarbonation, flexibility in operation, and a modern control room. The severe floods of 1982 did not interrupt service to customers in spite of the plant's location on low, unstable soil near the river. Flood damage was prevented by the 12,000 piles used as support and thick reinforced concrete construction for underground tanks. (Cassar-FRC)
W83-01808

TREATED WATER FOREVER PURE,
East Bay Municipal Utility District, Oakland, CA.
K. B. Stinson.
Water/Engineering and Management, Vol 129, No 10, p 34, 36, 71, September, 1982. 3 Ref.

Descriptors: *Water treatment, *Distribution reservoirs, *Drinking water, *Water conveyance, *Water storage, *Reviews, *Corrosion control, *Organoleptic properties, Potable water, Storage tanks, Water pollution prevention, Scaling, Color, Bacteria Odors, Fouling, Pipes.

The quality of source water, construction materials of distribution systems, and methods of construction and operation may all contribute to the deterioration of the quality of treated drinking water. For example, deposits of aluminum or iron salts may occur in waters of systems where these agents are used as coagulants to reduce color and turbidity. The adjustment of pH for corrosion prevention may cause high levels of aluminum to pass through filters. The addition of lime to adjust pH may also increase water turbidity. Intermittent increases in flow due to fires, main breaks or changes in demand may stir up sediments and shield bacteria from disinfection measures. Scaling may occur as deposits of calcium carbonate, iron oxides, manganese oxides, silicates or alumina build up in distribution systems or customers' piping. Some new synthetic coatings used to prevent corrosion of distribution materials may impart bad taste and odor qualities and support the growth of bacteria. Gasoline and mercaptans have been known to permeate plastic water services and cause taste and odor problems. Excess sunlight in distribution reservoirs may cause algal growth. Human and bird excreta may also find its way into open reservoirs. Contaminants may enter the system when a flooded air release valve draws a vacuum during a main break or fire. Effective backflow prevention devices are necessary to prevent contamination. Main tapping operations can inject pipe material into distribution systems. If normally closed valves are not exercised periodically, the buildup of contaminants may accelerate corrosion. (Geiger-FRC)
W83-01815

SPOKANE'S BLUE LAGOON,
Spokane City Dept. of Public Utilities, WA.
R. E. Saty.
Water/Engineering and Management, Vol 129, No 10, p 38, 40, September, 1982.

Descriptors: *Storage reservoir, *Reservoirs linings, *Membranes, *Elastomers, *Economic aspects, Water storage, Reservoir storage, Reservoirs, Reservoir operation, Drinking water, Rubber, *Washington, Spokane.

To meet EPA, state and local regulations on water quality, the 24-million-gallon Lincoln Heights Reservoir was recently upgraded. City engineers decided to line the reservoir with a 45-mil thick black flexible membrane and cover it with a specially designed 45-mil thick blue colored floating cover. The cover system, called Roofloat, is made of three 15-mil sheets of synthetic rubber encapsulating a reinforcing fabric. Down time was kept to a minimum while upgrading the reservoir. The Hypalon lining will remain flexible and elastic over a wide range of temperature. An elastomeric compound was used for strong seaming. A blue cover was chosen for aesthetic purposes, since the reservoir was adjacent to a retirement community and a city park. The cover reduces the amount of sunlight hitting the reservoir, thereby hindering algal growth, chlorine degradation, and evaporation. The floating cover also helps reduce the chances of accidental drowning. (Geiger-FRC)
W83-01816

MICROSCREENING EXPERIENCES,
Rexnord, Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5D.
W83-01817

CARBON SOLVES NEW JERSEY WATER-WELL POLLUTION CRISIS.
World Water, Vol 5, No 9, p 16, 29, 31, September, 1982.

Descriptors: *Water treatment, *Drinking water, *Carbon absorption, Odor, Taste, Well water, Wells, Diisopropyl ether, Methylene chloride, Tetrachloroethylene, Rockaway, *New Jersey.

The identification of diisopropyl ether and methylene chloride in drinking water samples in Rockaway Township, New Jersey required emergency steps to be taken. The source of the pollution was traced to a local gasoline station with a leaking storage tank. The construction of a treatment plant was ordered, while potable water stations were established for collection of supplies by individual inhabitants. THe system chosen called for pollutant removal through carbon absorption. In nearby Rockaway Borough a well showed traces of tetrachloroethylene and was closed down. However, within months the contamination had reached 554 ppb of PCE, and there was concern about other nearby wells. A similar carbon absorption system was installed to meet this emergency situation, and in both communities the problems were resolved. (Baker-FRC)
W83-01819

AGUA DEL PUEBLO BOOSTS QUALITY OF RURAL GUATEMALAN LIFE.
World Water, Vol 5, No 9, p 49, 51-53, September 1982.

Descriptors: *Water quality, *Public health, *Water resources development, Sanitation, Drinking water, Contamination, Rural areas, Rural sociology, Training, Education, *Guatemala.

Over 50 rural water supply projects were constructed in rural Guatemala through the efforts of a nonprofit technical assistance group, Agua del Pueblo. This approach to rural water and sanitation problems has from the outset involved training of talented local people to assist in the planning and construction of village systems. Extensive community involvement in virtually every aspect of a project is the guiding principle of the methodology. Through an extensive education program workers from the Aqua del Pueblo movement explain the superior benefits of house connections versus public taps. Water committees are the key to successful participatory water projects. They become responsible for collection of maintenance fees and loan payments from families and for repaying loans to the water program. (Baker-FRC)
W83-01839

INTERACTION OF HYDROLOGIZED AL AND POLYELECTROLYTE COAGULANTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, and P. Sricharoenchaikit.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 883-899, October, 1982. 11 Fig, 1 Tab, 17 Ref.

Descriptors: *Chemical reactions, *Coagulants, *Turbidity, Water quality, *Polyelectrolytes, *Aluminum, Acidity, Water treatment.

A laboratory jar test study was conducted to determine the mode of action of commercial cationic polyelectrolytes used in combination with aluminum salt coagulants. Electrophoretic mobility and residual turbidity data were collected as a function of coagulant dosage, solution chemistry, and the particle size distribution and concentrations of the silica particle suspension. Two general types of results were obtained, depending on the tendency of the hydrolyzed aluminum to form a flocculent precipitate. This tendency is a function of the solution chemistry, including pH, concentrations of adsorbing anions such as sulfate, and ionic strength. With dilute solutions and low pH the aluminum hydrolysis products tend to be stable, and under these conditions the cationic polyelectrolyte and the adsorbed hydrolyzed Al have similar effects on particle stability. Maximum turbidity removal is observed near an electrophoretic mobility of zero. A simple trade-off relationship exists between the amounts of Al and polyelectrolyte required to reach this point. When the aluminum hydrolysis products are flocculent a coating of aluminum hydroxide precipitate is apparently formed on the particles, which, as the aluminum concentration is increased, eventually controls particle stability and the efficiency of flocculation. (Baker-FRC)
W83-01896

CALIFORNIA'S SMALL WATER SYSTEMS PROGRAM: INSPECTIONS UP 60%; MAJOR DEFICIENCIES DOWN 37%,
San Bernardino County Dept. of Environmental Health Services, CA.
R. L. Roberts, and J. S. McGurk.
Journal of Environmental Health, Vol 45, No 2, p 80-82, September/October, 1982. 4 Fig.

Descriptors: *Inspection, *Interagency cooperation, *Water treatment facilities, Training, Education, *California, Public health, Grants.

Cooperation between California's state and local health agencies has resulted in an effective program for inspecting small water systems. As a result of this program, systems with major deficiencies have decreased from 38.9% in 1977-78 fiscal year to 22.5% in 1980-81 fiscal year among community systems and from 32.5% to 23.3% among non-community systems. The systems having no deficiencies increased from 20.9% to 32% among community systems and from 33.2% to 39% in non-community systems. Of the 10,806 systems in the program, 5960 were inspected in 1980-81 fiscal year. The programs's objectives, developed by a steering committee (California Conference of Directors of Environmental Health, State Department of Health Services, and California Conference of Local Health Officers) are to inventory and inspect small water systems, obtain corrections of deficiencies, and develop an effective evaluation system to measure the program's success. Funds are provided by an EPA grant for small water systems surveillance. The state staff members provide training for local staff members through workshops and personal contact during inspections. (Cassar-FRC)
W83-01911

MANAGEMENT'S ROLE IN CRIME PREVENTION,
Wackenhut Corp., Ponce de Leon, FL.
L. R. Riccio.
Journal of the American Water Works Association, Vol 74, No 10, p506-507, October, 1982.

Descriptors: *Water treatment facilities, *Management planning, *Security, Safety, Water managment, Fences, Utilties.

The Foreign Corrupt Practices Act requires chief officers of any company in the United States to take reasonable action to protect the company's assets. In water treatment facilities the burden of security against crime is often placed upon the plant manager. Professional security consultants have learned that there is no single solution to security for different establishments. Security consultants must know of the threat of crime in a specific water utility is external, internal, or both. Crime in a water utility would probably arise as vandalism and terrorism (external) or theft (internal). Loss of property would focus on physical security such as alarm systems, security guards, or barriers and preventing pilfering by keeping tools under lock and key or posting undercover agents amongst employees. Loss prevention surveys may be conducted by an experienced professional in the security field to pinpoint possible problem areas and suggest what improvments may be made. (Geiger-FRC)
W83-01912

WATER DISTRIBUTION SYSTEMS: A SPATIAL AND COST EVALUATION,
Municipal Environmental Research Lab., Cincinnati, OH.
R. M. Clark, C. L. Stafford, and J. A. Goodrich.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 243-256, October, 1982. 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Water mains, *Repairs, *Economic analysis, Water distribution, Land use, Land development, Cost analysis, Maintenance costs, Pipes, Rehabilitation, Water quality, Corrosion.

Problems in maintaining and replacing water supply distribution systems are associated with public health, economic and spatial development of the community, and costs of repair and replacement of system components. Using data from two utilities (a large facility pumping 150 mgd average through a 3900 mi distribution system and a small rural utility pumping an average of 18 mgd through a 360 mi distribution system) several statistical models and graphical displays were developed to relate water supply infrastructure development with population distribution and growth. A repair frequency analysis showed that over a 40 year period, 52.5% of pipes studied had no maintenance events, 48% had one, and 30% had 2. A minority of pipes were responsible for the majority of repairs. A life expectancy curve (years remaining without a maintenance event) ranged from an additional 11.2 years for an unbroken 5-year old main to 1 year for an unbroken 40 year old main. As the number of maintenance events in a given pipe increased, the time between failures decreased sharply. Curves plotting the annual cost of a system against repair costs indicate an optimal replacement date 30 years after installation. Factors were also developed to account for water corrosivity, agressive water producing 31% higher unit repair costs than harder water. Several other conclusions were reached. The first repairs in metallic pipes occur an average of 13 years later than in reinforced concrete pipes. However, metallic pipes require more repairs than do concrete pipes over the long term. Larger diameter pipes have a longer period before the first repair than smaller diameter pipes. A large percentage of industrial development in the area decreases the time until the first break. Increased development increases repeat breaks. (Cassar-FRC)
W83-01936

ECONOMIC ANALYSIS OF REHABILITATION OF WATER MAINS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6B.
W83-01937

COST ESTIMATING FOR CONVENTIONAL WATER TREATMENT,

Municipal Environmental Research Lab., Cincinnati, OH.
R. M. Clark.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 819-834, October 1982. 1 Fig, 6 Tab, 7 Ref.

Descriptors: *Estimating, *Cost analysis, *Water treatment, Drinking water, Potable water, Water quality, Equations, Mathematical equations, Water treatment facilities.

Cost equations are presented which can be used for water treatment unit process cost estimating. The need for pre-design estimates is discussed, and the factors affecting the reliability of cost estimates are examined. These factors include availability of basic data, stage of development, definition of scope, time expended on analysis, and experiences of the analyst. Data for these equations were derived from a carefully designed study to establish water supply unit process costs on a consistent and understandable basis. The basis for derivation of these curves is presented. Examples of the application of these equations are developed, bases on a standard layout for a water supply treatment plant and assumed standard values for the input factors for the cost equations. (Baker-FRC)
W83-01940

CHLORINE RESISTANCE PATTERNS OF BACTERIA FROM TWO DRINKING WATER DISTRIBUTION SYSTEMS,
California Univ., Irvine.
H. F. Ridgway, and B. H. Olson.
Applied and Environmental Microbiology, Vol 44, No 4, p 972-987, October, 1982. 13 Fig, 4 Tab, 36 Ref.

Descriptors: *Chlorine, *Chlorination, *Microorganisms, *Bacteria, *Resistance, *Sensitivity analysis, Drinking water, Biologicl filters, Water treatment, Disinfection, Suspended solids, Potable water, Actinomyces, Water analysis.

The relative chlorine sensitivities of bacteria isolated from chlorinated and unchlorinated drinking water distribution systems were compared by two different methods. In one method, the toxic effect of free chlorine on bacteria was measured, while in the other method,the effect of combined chlorine was recorded. Bacteria from the chlorinated system were more resistant to both forms of chlorine than were those from the unchlorinated system. Bacteria retained on the surfaces of 2.0-micron Nuclepore membrane filters were significantly more resistant to free chlorine than was the total microbial population recovered on 0.2-micron filters, probably because aggregated cells or bacteria attached to suspended particulates exhibit more resistance than unassociated microorganisms. The presence of attached bacteria was confirmed by scanning electron microscopy of suspended particulate matter. The most resistant isolates, which included gram-positive spore-forming bacilli, some micrococci and actinomyces, were able to survive a 20 minute exposure to free chlorine at levels of 10 milligrams/liter. The most sensitive bacteria were readily killed by chlorine concentrations of 1.0 milligrams/liter or less. (Geiger-FRC)
W83-01997

UNDERESTIMATION OF TOTAL-COLIFORM COUNTS BY THE MEMBRANE FILTER VERIFICATION PROCEDURE,
Wisconsin State Lab. of Hygiene, Madison.
J. H. Standridge, and J. J. Delfino.
Applied and Environmental Microbiology, Vol 44, No 4, p 1001-1003, October, 1982. 2 Tab, 13 Ref.

Descriptors: *Microbiological studies, Drinking water, *Coliforms, *Citrobacter, Water quality control, *Culture media, Bacteria, *Membrane filters, Culturing techniques, Testing procedures, Water analysis,, Metabolism.

Quality assurance in microbiology laboratories has become especially important in the analysis of total coliforms in drinking water. Research along these lines has led to the discovery that both the standard most-probable-number technique and the membrane filter technique result in a significant underestimation of coliform numbers in drinking water supplies. Coliforms, primarily Citrobacter freundii, were found to give negative verification results in the total-coliform membrane filtration test due to peptone sources used in the media. The organisms produced gas from lactose in brilliant green bile broth but not in lauryl tryptose broth. Since nitrogen-containing nutrients in the medium can affect the metabolic pathway chosen by the coliforms, the use of a different medium is suggested to solve the problem. (Geiger-FRC)
W83-01998

A BRIEF REVIEW OF THE CURRENT STATUS OF ALTERNATIVES TO CHLORINE DISINFECTION OF WATER,
Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
A. C. Anderson, R. S. Reimers, and P. deKernion.
American Journal of Public Health, Vol 72, No 11, p 1290-1293, November, 1982. 1 Tab, 32 Ref.

Descriptors: *Disinfection, *Chlorine, *Bromine, *Ozonation, *Water treatment, *Ultraviolet radiation, *Ultrasonics, *Reviews, *Comparison studies, Chlorination, Wastewater treatment, Electromagnetic waves, Drinking water.

Alternative methods to chlorination for the disinfection of drinking water and wastewater are reviewed. Chlorine dioxide is a stronger oxidant than chlorine and effectively destroys coliforms, enteroviruses, and pathogenic amebas. It does not react with ammonia or aromatic organics and does not produce trihalomethanes. The disadvantages of chlorine dioxide include its cost and production problems. Ozone does not form trihalomethanes in water, and can also remove trihalomethane precursors. The lack of information on the organic reaction products of ozone is a cause for concern about its use as a disinfectant. Since ozone does not form a residual, it must be used in conjunction with another disinfectant to protect the distribution system. Bromine chloride is more reactive than chlorine for inactivating enteric viruses and coliforms in wastewater. More testing is needed on human and aquatic toxic effects before bromine chloride can be fully used as an alternative disinfectant. Recent advances in equipment design are making disinfection by ultraviolet (UV) light more feasible. Intense doses of UV are required to inactivate bacterial and fungal spores and protozoa. UV produces no chemical by-products or toxic residues, but must be used with another disinfectant to maintain disinfection throughout the distribution system. Ultrasound is relatively expensive and can be rendered ineffective by thick films of water. Recent research has confirmed the ability of electrostatic processes to reduce bacteria and viruses along with boiler scale and corrosion. (Geiger-FRC)
W83-02016

THE NEED FOR PREVENTIVE CONTROL OF DRINKING WATER CONTAMINANTS,
Princeton Univ., NJ. Center for Energy and Environmental Studies.
For primary bibliographic entry see Field 5G.
W83-02031

ALTERNATIVE DISINFECTION METHODS - A COMPARISON OF UV AND OZONE,
Photox International, Inc., Houston, TX.
R. W. Legan.
Industrial Water Engineering, Vol 19, No 2, p 12-25, March/April, 1982. 7 Fig, 8 Tab, 6 Ref.

Descriptors: *Disinfection, *Chlorination, *Ozone, *Ultraviolet light, Photoreactivation, Drinking water, *Water treatment.

Up-to-date information is presented on disinfection methods, their efficiency and their cost. The discussion focuses primarily on ultraviolet light and ozone as the main disinfection alternatives, as they are the most likely method to ultimately replace chlorine. In spite of various difficulties with chlorination, if a disinfection alternative for a 30/30 effluent stream (30 mg/liter BOD and 30 mg/liter TSS) is to be purchased currently, based only on the criterion that it is proven technology, the chlorination/dechlorination process is the only choice. Since 1965 a number of laboratory and pilot-plant studies have been conducted to evaluate the effectiveness of ozone in disinfecting wastewater, both as an oxidant and as a germicidal compound. Technology in the ultraviolet light field has developed to such a point that it can now be used to efficiently and economically disinfect water streams. Problems of turbidity, short-circuiting, and photoreactivation using ultraviolet light disinfection systems are considered. (Baker-FRC)
W83-02083

CHARACTERIZATION OF INDICATOR BACTERIA IN MUNICIPAL RAW WATER, DRINKING WATER, AND NEW MAIN WATER SAMPLES,
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
J. A. Clark, C. A. Burger, and L. E. Sabatinos.
Canadian Journal of Microbiology, Vol 28, No 9, p 1002-1013, September, 1982. 1 Fig, 6 Tab, 10 Ref.

Descriptors: *Pollutant identifcation, *Bacteria, *Bioindicators, *Water pollution sources, *Municipal water, *Water analysis, *Computers, Escherichia coli, Enterobacter, Aeromonas, Klebsiella, Citrobacter, Indicators, Water treatment, Raw water, Drinking water, Membrane filters.

A computerized system was developed for handling data on municipal water samples that were analyzed by membrane filter (MF) and presence-absence (PA) tests for pollution indicator bacteria. Over a four-yr period, 11,514 bacterial cultures were isolated from either raw water, drinking water, or new main water samples analyzed by three laboratories. The species occurring most often in all types of water samples were Eschericia coli, Enterobacter aerogenes, Aeromonas hydrophila, Klebsiella pneumoniae, and Citrobacter freundii. In the presumptive portion of the PA test, a lactose-lauryl tryptose broth was examined as an alternative medium to modified MacConkey broth. The intensity of acid and gas production in presumptive positive PA bottles was compared with the types and frequencies of indicator bacteria demonstrated by confirmatory tests. The results of detecting indicator bacteria after analysis of 53,130 samples over a 2-year period were catagorized by water source and type to determine the effect of these parameters on the recovery of indicator bacteria. Further subdivision of sample types according to source illustrated the effects of water treatment practices on the presence of indicator bacteria. (Geiger-FRC)
W83-02097

5G. Water Quality Control

THE DIVERSION BOX: A PROVEN TECHNOLOGY FOR POLLUTION ABATEMENT,
Altamonte Springs Public Works Dept., FL.
D. F. Newnham, S. M. Gilbertson, and M. G. Crumpton.
Public Works, Vol 113, No 10, p 54-55, October, 1982. 3 Fig.

Descriptors: *Storm water, *Diversion structures, Retention, Ponds, Weirs, Water pollution control.

An inexpensive, easily maintained, and highly effective diversion box diverts the initial flush of polluted storm water to a retention facility for subsequent treatment. The configuration of the pond and the height of the weir are chosen so that the pond will gradually fill and the water in the pond and in the input side of the diversion box will rise to the top of the weir after the first inch of storm water has been received. As additional, cleaner water enters the box, the water level flows over the weir into the outlet side of the structure. The polluted water in the pond cannot return into the diversion box. When the water flow on the inlet side of the box decreases, the flow over the weir box ceases abruptly, and the outlet side of the box is routed to a receiving water body. The

diversion box prevents pollution accumulated in several minor storms from being flushed from the retention pond during a major storm. (Cassar-FRC)
W83-01822

EVALUATION OF FILTER FABRICS FOR USE IN SILT FENCES,
D. C. Wyant.
Transportation Research Record, Vol 832, p 6-12, 1981. 2 Fig, 6 Tab, 8 Ref.

Descriptors: *Road construction, *Highway effects, *Performance evaluation, *Erosion control, *Fabrics, Soil erosion, Erosion, Silt load, Silt, Strength, Filtration, Flow rates.

A study was conducted to develop data to be used in purchasing filter fabrics for building silt fences on highway construction projects. Seven performance tests were carried out on each of fifteen fabrics. Two of the tests - laboratory filtering efficiency and tensile strength - have been adopted by the Virginia Department of Highways and Transportation for choosing filter fabrics to be used on construction projects. These two tests help ascertain filtering efficiency, flow rate, and warp tensile strength. A third test for determining resistance to damage by ultraviolet rays was not recommended to the department for use due to its lack of reproducibility. More work is needed on ways to evaluate this critical parameter. (Geiger-FRC)
W83-01830

CLEANING UP A HAZARDOUS WASTES SITE CATASTROPHE,
O.H. Materials Co., Findlay, OH.
J. T. Vielhaber, and J. R. Van Meter.
Industrial Wastes, Vol 28, No 5, p 16-18, September/October, 1982.

Descriptors: *Hazardous materials, *Accidents, *Cleanup operations, *Waste management, Water analysis, Chemical analysis, Explosions, Environmental effects, Cleanup, Decontamination, Fate of pollutants.

Hazardous waste cleanup operations were required following a disastrous fire at the Chemical Control Corporation, a hazardous wastes treatment and disposal facility located in Elizabeth, New Jersey. The fire resulted from an explosion of 60,000 barrels of toxic wastes and chemicals. Based on preliminary testing of air, soil and water, three zones of contamination were established. Much of the storage that had been performed at the company had been alleged to be illegal, and there was no documentation to indicate the materials stored. Most labels were destroyed in the fire. A barrel grappler was designed and fabricated, modeled after the grapplers used by loggers in the northwest. Rapid turn-around time for analysis was essential for proper identification of contaminants. Sophisticated laboratory equipment including GC/MS and atomic absorption units provided for thorough analysis of over 30,000 samples at minimum expense. Thus the emergency was dealt with through remote, safe and efficient drum handling techniques, aggregate bulking of compatible waste, on-site mobile laboratory services, and the recovery and on-site treatment of contaminated groundwater. (Baker-FRC)
W83-01837

WHO IS KILLING THE RHINE,
M. J. Kurlansky.
Environment, Vol 24, No 7, p 41-42, September, 1982.

Descriptors: *Drinking water, *Water pollution control, *Industrial wastes, Water pollution sources, *Rhine River, Regulations, Water management, Salt, Arsenic, Heavy metals, Radioactive wastes, Legislation, *Netherlands.

The Rhine River provides the source of 80% of the Dutch drinking water, feeds the soil for agriculture, flushes the sea water out of the coastal lands and canals, provides transportation through a network of tributaries and canals, and is a food source for man and wildlife. Through negligence the water supply is being damaged by the Swiss, West Germans, French and the Dutch themselves, as it is being contaminated with salt, arsenic, mercury, cadmium, chromium, DDT, PCBs, radioactive tritium, petroleum, copper, zinc, lead, and other substances of industrial origin. An accord on chemical pollution was ratified by the Rhine countries in 1979. The agreement was made to fix maximum allowable discharge levels for each substance. To date the only substance these countries have acted on is mercury, a highly toxic heavy metal that has shown signs of a reduced presence in the river. The Rheinwater Foundation and ten other Dutch organizations are establishing an International Water Tribunal which will convene in April 1983 to review and lobby for the redress of individual cases of pollution in the Rhine-North Sea water system. (Baker-FRC)
W83-01838

CLOSED CYCLE INDUSTRIAL WASTES CONTROL,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. H. Smith, and J. H. Oates.
Industrial Wastes, Vol 28, No 4, p 30-31, July/August. 1982 1 Fig, 2 Tab.

Descriptors: *Wastewater irrigation, *Irrigation water, *Food-processing wastes, Potatoes, Land reclamation, Caldwell, *Idaho, Livestock, Manure, Animal wastes, Forages, Wastewater treatment, Nitrites, Industrial wastes.

All the 4.5 mgd of wastewater from the J. R. Simplot Company potato processing plant and livestock feeding operation in Caldwell, Idaho, is applied to nearby grass and corn fields. No wastewater has been discharged into the adjacent Boise River since 1972. Application, although still somewhat uneven with respect to volume and nutrients, averages 48 inches per year over the 800 acres. During passage through the soil, removal of COD and plant nutrients is essentially 100%. Groundwater quality is good. Nitrates average 0.3 mg per liter, a result of rapid denitrification in the shallow water table. One effect of this disposal process has been to reclaim the land by leaching saline solids from the formerly saline fields. Average yield of grass is 18-20 tons per acre. (Cassar-FRC)
W83-01843

CLOSING THE CIRCLE ON WASTEWATER TREATMENT.
Industrial Wastes, Vol 28, No 4, p 21-22, July/August, 1982. 4 Tab.

Descriptors: *Information exchange, *Industrial wastes, *Waste management, Wastewater treatment, Waste treatment, Midwest Industrial Waste Exchange, Waste disposal.

The Midwest Industrial Waste Exchange, St. Louis, Missouri, started in 1975, serves as an information exchange and matchmaker for industrial waste generators and users. For example, waste from one industry may be used as a raw material in another process, or 2 wastes (acid and base) may be used for mutual treatment. A catalog published every 3 months (with supplements) lists available and desired wastes. The May 15, 1982, catalog had 86 available listings, 20 wanted listings, and 5348 subscribers. Inquiries average 56 a month. Successful exchanges from June 1980 to September 1981 totaled 21, with 70 transactions in the negotiation stage. (Cassar-FRC)
W83-01845

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY (1980).
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Economic and Technical Review Report EPS 3-WP-82-3, July 1982, 26 p, 2 Fig, 10 Tab, (also in French).

Descriptors: *Pulp and paper industry, *Water pollution control, *Industrial wastewater, *Canada, Biochemical oxygen demand, Suspended solids, Process control, Toxicity, Costs, Sulfite mills.

Regulations to limit the discharge of pollutants in liquid effluents from the Canadian pulp and paper industry were promulgated by the federal government in 1971. Between 1978 an 1980, pulp and paper production increased about 1.5%. Total suspended solids (TSS) discharged were reduced by about 6%, and BOD was reduced by about 3%. Reductions in TSS on a per tonne basis were noted for all regions except the Northwest region, where discharges remained stable, and in Quebec region where TSS per tonne increased slightly. On a per tonne basis, BOD5 discharges were lower in all regions except Quebec. Many mills do not yet have compliance schedules for reductions in the toxicity of effluents to fish. Some mills have been successfully using internal measures with-out bio-treatment to reduce toxicity. Between 1969 and 1980, inclusive, the expenditures on abatement facilities have amounted to about $661,000,000. Process changes, such as the use of thermo-mechanical pulp, have been suggested as one of the possible solutions to difficulties in the abatement program for the newsprint sulfite sector of the industry. The Environmental Protection Service continues to encourage the submission of compliance programs in which in-plant controls are to be implemented. This approach fosters the principle of prevention rather than treatment. Reduction of the total pollutant discharge is important because many pollutants are refractory to biological treatment. (Moore-SRC)
W83-01886

COST-EFFECTIVE PRETREATMENT PROGRAMS,
Environmental Protection Agency, Cincinnati, OH.
L. A. Rossman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 665-679, August, 1982. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Industrial wastewater, *Cost-benefit analysis, *Pretreatment of wastewater, Municipal wastewater, Wastewater treatment, Cost allocation, Model studies, Water quality control, Sludge, Kokomo, *Indiana, Heavy metals, Metals, Economic aspects, Effluent limitations.

A method is developed for planning cost-effective integrated industrial-municipal pretreatment programs for toxic pollutants. It uses mathematical programming to determine the levels of industrial pretreatment and municipal treatment which will meet the relevant environmental standards (sewer discharges, receiving water quality, and sludge quality) at minimum total cost. The problem is formulated as a nonlinear 0-1 integer program model. An implicit enumeration procedure that exploits the special structure of the problem is used for the solution. An analysis of heavy metals in the Kokomo, Indiana, treatment system showed that using uniform national standards for pretreatment was less cost-effective than using no minimum standards. Industrial sources accounted for 28% of total flow and 67-99% of Cd, Cr, Cu, Ni, and Zn entering the municipal plant. Cu was the critical receiving water parameter. If all Cu from the industrial sources were eliminated, other contributing sources would cause violation of the EPA limit 36% of the time using secondary municipal treatment and 22% of the time using tertiary municipal treatment. This method allows a city's pretreatment requirements to be matched to local conditions. Using the desired receiving water quality as a goal, the treatment is distributed among the individual industries and the municipal plants on a cost-effective basis. In general, the industry with the largest pollutant input is required to treat to a higher level. The problem of differences in treatment levels may cause complaints of inequity, which must be resolved. (Cassar-FRC)
W83-01903

MODELING AND INTERPRETING OXYGEN TRANSFER DATA,

Tufts Univ., Medford, MA. Dept. of Civil Engineering.
L. C. Brown, and C. R. Baillod.
Journal of the Environmental Engineering Division, Prodeedings of the American Society of Civil Engineers, Vol 108, No EE4, p 607-628, August 1982. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Oxygen transfer, *Aeration, Wastewater treatmet, Kinetics, Model studies, Design criteria, Mixing, Mass transfer, Dissolved oxygen.

Recommendations for modeling, parameter estimation, and experimental design in unsteady state clean water aeration tests are given. The best model for analysis of both surface and subsurface oxygen transfer test data is the exponential form of the first order mass transfer equation. It fits most of the observed data, but overestimates the average driving force during the unsteady state test. The model, which applies to a given aeration system in a given tank under steady-state hydraulic conditions, can be viewed either as based on a completely mixed system with uniform dissolved oxygen values in which oxygen is transferred throughout the tank volume or as based on a compartmentalized system in which oxygen transfer is confined to a localized aeration zone. A nonlinear least squares regression procedure is recommended for estimating the oxygen transfer coefficient and equilibrium saturation concentration. The Best Fit Log Deficit Method is an acceptable alternate procedure usable when a computer is unavailable. Techniques for selecting the number and spacing of data values and for assessing model adequacy are suggested. A sample problem illustrates the given procedure for applying clean water test results to field water conditions. (Cassar-FRC)
W83-01938

LAKE PHYTOPLANKTON MODEL WITH DESTRATIFICATION,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. S. Gulliver, and H. G. Stefan.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 864-882, October, 1982. 12 Fig, 1 Tab, 28 Ref.

Descriptors: *Lake management, *Phytoplankton, *Phosphorus, Nutrients, Phosphates, Seasonal variation, Sediments, Chlorophyll, Model studies, Lake Calhoun, Destratification, Eutrophication, *Minnesota.

The phytoplankton mass and available phosphorus during a destratification experiment conducted at Lake Calhoun, Minnesota, in 1972 are simulated by a numerical, multilayered, unsteady numerical model. A time scale of one day is used. The effects of surface mixed layer dynamics, phosphate-phosphorus inflows from surface runoff, recycling of phosphate-phosphorus from the sediments, available light, temperature, and mixing in the hypolimnion on phytoplankton productivity are analyzed. The model was used to hindcast the events of 1972 and to explore the effects of lake management alternatives such as the reduction of phosphate-phosphorus runoff, the elimination of phosphorus recycling, and the maintenance of an artificially deepened surface layer. According to model results the phosphate-phosphorus released by sediments did not influence surface layer phytoplankton populations except during the destratification experiment and during fall turnover. In both cases the strongly stratified, metalimnion-resisting vertical transport was destroyed. High phosphate-phosphorus concentrations in the spring are in part attributable to internal loading from the previous summer. (Baker-FRC)
W83-01939

STORMWATER POLLUTION CONTROL: BEST MANAGEMENT PRACTICES,
Santa Clara Univ., CA. Dept. of Civil Engineering.
E. J. Finnemore.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 108, No EE5, p 835-851, October, 1982. 1 Fig, 2 Tab, 24 Ref.

Descriptors: *Water pollution control, *Storm runoff, Storm wastewater, Water pollution sources, Street cleaning, Heavy metals, Suspended solids, Sediment transport, Erosion, Erosion control, California, Cost analysis, Maryland, Urban runoff, Management, Washington.

Case studies are presented which describe four instances in which successful and very promising best management practices (BMPs) were employed for nonstructural and elementary structural stormwater pollution control. Their approaches, implementation, and resulting performance, costs and impacts are described for the use of planners and designers. In Bellevue, Washington, an innovative stormwater utility has effectively administered Bellevue's stormwater management program. In a regional approach at Montgomery County, Maryland, many source controls have minimized erosion and removed most pollution from urban runoff at moderate costs. Near Lake Tahoe, in California, planning for stormwater management aided by erosion controls has prevented tremendous increases in sediment yields. At San Jose, California, extensive studies revealed that improved street cleaning will effectively control total solids and heavy metals in runoff. (Baker-FRC)
W83-01941

DECARBONATION OF LIMESTONE-TREATED MINE DRAINAGE,
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
F. Pearson, S. McBride, and N. Batcheler.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 957-972, October, 1982. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Mine drainage, *Decarbonation, *Water pollution control, Limestone, Drainage, Acidity, Percolation, Leaching, *Pennsylvania, Hazelton.

Crushed limestone is used in various processes to neutralize acid mine drainage in a 2.5 mgd facility near Hazelton, Pennsylvania. A 0.5 mgd stream was treated by two limestone packed tumbling drums in series to increase pH from 3.7 to 5.4 followed by a lagoon for carbon dioxide removal that further increased pH to 6.1, to meet the pH 6 effluent quality target. Decarbonation process theory and design procedures are proposed. Graphs show pH increase versus carbon dioxide removal and carbon dioxide removal versus time of treatment as well as the overall film transfer coefficient. Nomographs also show how carbon dioxide removal depends on air-to-water ratio, air-water contact time, bubble or droplet diameter, and the turbulence-dependent film transfer coefficient. Use of nomographs is illustrated by calculation of the film transfer coefficient from experimental data. (Baker-FRC)
W83-01942

STORMWATER POLLUTION CONTROL: STRUCTURAL MEASURES,
Santa Clara Univ., CA. Dept. of Civil Engineering.
E. J. Finnemore.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE4, p 706-721, August, 1982. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Storm wastewater, *Combined sewer overflows, *Sewer systems, Water quality control, Overflows, Water pollution control, Seattle, Washington, Saginaw, Michigan, Mount Clemens, Wastewater treatment, Storm sewers, Cost-benefit analysis, Water storage, Control systems.

A review of information on costs, feasibilities and efficiences of combined sewer overflow (CSO) control measures reveals that no one method can handle all CSO problems. The most important feature of cost-effective structural control measures is storage. It attenuates peak flows, reduces overflows, and contains pollutants. Integration between storage and treatment is particularly effective because it can use the existing collection system, can use the most cost-effective combination of storage and treatment, and can integrate CSO controls with other facilities and projects to achieve higher levels of pollution control. Three case studies of CSO control programs are described. Seattle, Washington, uses computerized in-line storage in existing sewer interceptors and trunk sewers. Saginaw, Michigan, integrates off-line storage/treatment with in-line storage and dry weather treatment to attain high performance at moderate costs. At Mount Clemens, Michigan, the control program includes partial sewer separation, interception of overflows, and combined sewer storage and treatment facilities associated with a multiuse park and lake system for final polishing. Selecting an appropriate CSO control for a given site should consider reduction of total overflow volume, reduction of frequency of overflow events, and reduction of pollutant loadings to receiving waters. Tables comparing cost and performance for the three systems are given as a planning aid. Selection should also consider size, complexity, and ways to combine components and integrate them with other facilities. (Cassar-FRC)
W83-01944

WATER QUALITY INVENTORY AND MONITORING PROGRAM FOR THE COMMONWEALTH OF VIRGINIA: STATE-OF-THE-ART,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 10C.
W83-01949

UNCERTAINTY ANALYSIS OF DISSOLVED OXYGEN MODEL,
Villanova Univ., PA. Dept. of Civil Engineering.
R. A. Chadderton, A. C. Miller, and A. J. McDonnell.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE5, p 1003-1013, October, 1982. 7 Tab, 14 Ref.

Descriptors: *Dissolved oxygen, *Model studies, *Uncertainty analysis, Prediction, Estimating, *Streeter-Phelps equation, Mathematical equations, Mathematical studies, Streams, *Deoxygenation, Oxygen, Water quality, *Reaeration.

First-order uncertainty analysis was applied to 258 stream segments to determine the relative contributions to scatter or uncertainty in dissolved oxygen predictions by each of the parameters of the Streeter-Phelps equation. For very sluggish streams with reaeration rates less than about 0.1 per day, the most important parameters for dissolved oxygen predictions were the initial deficit and the deoxygenation rate constant. For streams having reaeration coefficients greater than 0.1 per day the most important parameter corresponded to the predominant aspect of the oxygen balancing mechanism for the stream segment. On the depletion portion of the dissolved oxygen sag curve, where deoxygenation exceeds reaeration, the deoxygenation rate constant contributed most of the uncertainty in dissolved oxygen prediction. However, on the recovery portion of the dissolved oxygen sag curve, where reaeration exceeded deoxygenation, the reaeration rate constant contributed most of the uncertainty in dissolved oxygen predictions. Application of the uncertainty analysis to identify critical water quality parameters for a given stream would lead to more efficient data collection efforts. (Baker-FRC)
W83-01961

NEW CHALLENGES IN THE GREAT LAKE STATES TO BANNING PHOSPHORUS IN DETERGENTS,
K. C. Flynn.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1342-1345, October, 1982. 1 Fig, 1 Tab.

Descriptors: *Detergents, *Phosphates, *Water pollution control, Legislation, Bans, Regulations, State jurisdiction, Legal aspects, *Great Lakes region, Canada, Wisconsin, Michigan, Indiana, Minnesota, New York, Chicago.

Since the early 1970's, attempts to control the amount of phosphorus reaching the Great Lakes have been a matter of grave concern to states in the northern United States and to Canadian provinces in the Great Lakes Basin area. One of the most effective steps taken to ensure such control was the passing of bans against the use of detergents containing phosphates. Recently this effective measure was apparently weakened in Wisconsin, where a 3-year ban was allowed to expire without being renewed. Arguments are presented on both sides of the issues. One side claims that improved wastewater treatment now makes such bans unnecessary. The other side claims that lifting bans now would be somewhat premature. With phosphorus detergent bans or limitations still in effect in Canada, Indiana, Minnesota, Michigan, New York and Chicago, there is no immediate concern that the Wisconsin decision will cause a domino effect, with a rush to lift all the bans. However, it is expected that the next time this issue comes before a state legislature there is bound to be more debate than occurred in Wisconsin. (Baker-FRC)
W83-01967

NPDES RULES FOR INDUSTRIAL DISCHARGERS: NEW OBLIGATIONS, NEW OPPORTUNITIES,
Smith and Schnacke, Dayton, OH.
R. S. Frye.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1349-1354, October, 1982. 7 Ref.

Descriptors: *Regulation, *Industrial wastes, Industrial discharges, Effluents, Water quality, Water pollution control, Legislation, Legal aspects, NPDES.

The most important aspects of the existing regulations regarding industrial dischargers are reviewed, expected changes are summarized, and some strategies are suggested for obtaining the most reasonable permit conditions within this regulatory scheme. It is concluded that in order to obtain the best result and highest cost savings from the NPDES permitting process, it is necessary to be closely acquainted with the applicable rules and with anticipated changes. Preparation must be made well ahead of time for any permit, permit renewal, or permit modification. One should be aware of deadlines for applications, requests for modifications, and variance requests. State requirements may be different from federal requirements. Case-by-case effluent limitations that will remain in effect even if less strigent national effluent limitations guidelines are subsequently published should be avoided. The form in which effluent limitations are expressed and the associated compliance monitoring requirements can be as important as the technological basis for those limitations. If the discharge is water-quality limited, one must keep track of and participate in the state's water quality management planning for the receiving stream. (Baker-FRC)
W83-01968

RELATION OF INFLOW/INFILTRATION COSTS TO VARYING POLICY REQUIREMENTS,
National Semiconductor Corp., Santa Clara, CA.
D. I. Wilkowsky, C. T. Way, D. L. Tucker, and D. S. Parker.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1361-1375, October, 1982. 11 Fig, 6 Tab, 2 Ref.

Descriptors: *Inflow, *Infiltration, *Cost analysis, Requirements, Regulations, Hydraulic profiles, Water quality, Permits, Wastewater treatment.

The costs of managing wet weather induced inflow and infiltration with the policy requirements of the federal and state water quality agencies are contrasted. The presentation describes the framework in which the study was conducted, illustrates the techniques used for coordinating the study with regulatory agencies during the conduct of the study, and presents the costs of alternative levels of improvements. Many of the permit conditions tested increased overall treatment costs without substantial increases in water quality. With the exception of two no-project alternatives and one satellite treatment alternative with treatment facilities remote from the Water Pollution Control Plant (WPCP), the alternative control plans centered around various schemes for storing the diluted wastewater until the storm passed, and then on diminution of the storm event, returning the stored wastewater for subsequent treatment at the WPCP. This project involved consideration of varying levels of pollution control. The alternative selected provided three storage locations. The connections from the collection agencies' system to the district interceptors currently provide a hydraulic bottleneck for wet-weather flows. Upstream overflows of collection systems would continue until corrected by the ongoing efforts of the collection agencies. This alternative gave the greatest reduction of existing overflows for the least cost. (Baker-FRC)
W83-01969

ENVIRONMENTAL EFFECTS OF A MEDIUM-FERTILITY 12-MONTH PASTURE PROGRAM: I. HYDROLOGY AND SOIL LOSS,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, R. W. Van Keuren, and W.M. Edwards.
Journal of Environmental Quality, Vol 11, No 2, p 236-240, April-June, 1982. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Surface runoff, *Pasture management, *Soil erosion, Hydrologic budget, Cattle, Runoff volume, Agricultural runoff, Grazing, Erosion control, Watershed studies, Soil conservation, Watershed protection.

The hydrologic and soil erosion changes resulting from two beef cattle pasturing programs were investigated in four small, sloping upland watersheds in Ohio over a 5-year period. The cattle grazed all four pastures rotationally between May and October each year. One plot was also used for wintering the cattle on hay all five winters. The pastures, which had previously been in meadow and light pasturing, had long-term average surface runoffs of about 15 millimeters per year. A slight increase in surface runoff and a trace of soil loss was found in the three pastures with summer grazing only over the 5 years of the study. However, the pasture which was used for both summer grazing and winter feeding showed a large increase in surface runoff, which averaged about 130 millimeters per year during the study. Soil loss also increased sharply to 1,355 kilograms per hectare per year, with 81% of this loss occurring during the dormant season. Although large runoff events were only a small percentage of the total number of events, they produced most of the runoff volume and most of the soil loss. Water balance studies indicated that the subsurface flow was relatively unchanged by the grazing program. The increase in surface runoff was offset by a decrease in evapotranspiration. (Carroll-FRC)
W83-01973

ENVIRONMENTAL EFFECTS OF A MEDIUM-FERTILITY 12-MONTH PASTURE PROGRAM: II. NITROGEN,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, R. W. Van Keuren, and W. M. Edwards.
Journal of Environmental Quality, Vol 11, No 2, p 241-246, April-June, 1982. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Nitrogen, *Pasture management, *Agricultural runoff, Cattle, Grazing, Surface runoff, Soil erosion, Groundwater runoff, Water pollution, Nitrates, Path of pollutants, *Ohio, Nonpoint pollution sources.

The effects of two beef cattle pasturing programs on nitrogen levels in water were investigated in four small, sloping upland watersheds in Ohio over a 5-year period. The cattle grazed all four pastures rotationally between May and October. One plot was also used for wintering the cattle on hay all five winters. Nitrate-nitrogen and ammonium-nitrogen concentrations were determined for precipitation, surface runoff, subsurface flow, and sediment. The nitrate-nitrogen level was generally higher in the surface runoff from the winter feeding plot than from the summer-grazing-only plots, but rarely resulted in any significant impairment of water quality. The nitrogen transported in the subsurface flow from the summer grazing only pastures was about equal to that transported from the wintering plot and to the amount of nitrogen received in the precipitation. The increased surface runoff and soil erosion resulting from the reduction of vegetative cover and increased soil disturbance on the pasture used for wintering cattle resulted in the transport of much greater quantities of nitrogen in surface runoff and sediment from this plot as compared to the summer grazing only plots. The pastures used only for summer grazing experienced very little surface runoff and only a trace of soil loss. Surface and subsurface losses of nitrogen from the winter feeding area were nearly equal. Although large storms represented only a small percentage of the total number of events, they transported a large proportion of the nitrogen. (Carroll-FRC)
W83-01974

ANALYZING TRANSPORTATION-RELATED HAZARDOUS MATERIAL SPILLS IN NEW ENGLAND,
Worcester Polytechnic Inst., MA.
T. C. Crusberg, and D. L. Smith.
Journal of the American Water Works Association, Vol 74, No 10, p 499-505, October, 1982. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Federal jurisdiction, *Water pollution prevention, Water pollution control, *Hazardous materials, *Transportation, *Accidents, *New England, Drinking water, Toxins, Poisons, Surface water, *Regulations, Legal aspects.

Transportation-related hazardous material spills present a substantial threat to surface water supplies in New England. A statistical analysis of reports made to the United States Environmental Protection Agency in Region I (Lexington, Massachusetts) shows that informing the federal government of such spills is subject to considerable underreporting. To enact legislation to deal with hazardous spills and protect watersheds, the federal government requires more accurate information regarding the severity and incidence of hazardous material spills due to transportation accidents. From 1978 to 1981, the number of transportation-related spills entering surface water in New England was 178. Of these, very few were reported to the federal government. The regulations now being promulgated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (PL 96-510) should provide the necessary legal framework to enforce a universal reporting program for spills of all hazardous materials. (Geiger-FRC)
W83-02028

THE NEED FOR PREVENTIVE CONTROL OF DRINKING WATER CONTAMINANTS,
Princeton Univ., NJ. Center for Energy and Environmental Studies.
G. L. Singer.
Journal of the American Water Works Association, Vol 74, No 10, p 18, 49, October, 1982.

Descriptors: *Water quality control, *Water pollution prevention, *Monitoring, *Water quality standards, *Public health, *Drinking water, *Cost-benefit analysis, Water treatment, Water quality management, Safety, Groundwater management, Water law.

The testimony of Grace L. Singer before the United States Senate subcommittee concerning toxic substances and environmental oversight relating to the Safe Drinking Water Act of May 26, 1982, is presented in abridged form. Only 16 chemicals are regulated under the Safe Drinking Water Act. Compared to European nations, the United States conducts very infrequent monitoring for toxic chemicals in surface or groundwater supplies. In some European water treatment plants, continuous monitoring tests using trout are performed to assess the quality of incoming raw

water. While groundwater protection measures are moving forward in Europe, in the United States they have been stalled since 1980 due to proposed amendments which will weaken both the Safe Drinking Water Act and the Clean Water Act. Within the limits of cost considerations, the EPA must regulate the contaminants which have any adverse effects on public health. In Europe, where water treatment can include steps involving granular activated carbon and ozonation for disinfection, the treatment cost may be only 10-20% of the cost of delivered water, with the remainder covering distribution, administration, etc. Based on EPA estimates for New Jersey, costs of water treatment ranged from $16 to $27 annually per household for a 5 to 66-mgd treatment plant. A cost criterion based on a per capita or per household unit seems to be a logical way of computing a cost-benefit analysis. A groundwater protection strategy should be a major goal of watershed protection rather than counting on expensive eater treatment later. (Geiger-FRC)
W83-02031

GROUNDWATER QUALITY MANAGEMENT,
Oklahoma Univ., Norman.
L. W. Canter.
Journal of the American Water Works Association, Vol 74, No 10, p 521-527, October, 1982. 6 Tab, 3 Ref.

Descriptors: *Groundwater management, *Water resources development, *Water quality management, *Case studies, *Project planning, *Aquifer management, Oklahoma, Groundwater potential, Aquifers, Water supply development, Protection, Future planning.

A case study related to developing a groundwater quality management plan is reviewed, and some options relative to the development of a national groundwater protection strategy and the research programs of the National Center for Ground Water Research (NCGWR) are described. A comprehensive four year study program was submitted by the Association of Central Oklahoma Governments (ACOG) to Congress to gather information for the continued use and development of the Garber-Wellington (G-W) aquifer that serves central Oklahoma. A preliminary study was conducted by the University of Oklahoma to collect existing data on the G-W aquifer and plan how to divide work tasks for the more expensive long term study. A computer-based literature survey of the preliminary study provided data on groundwater quality management. Nine data gaps were defined and given priority as subjects for tasks in the four-year study. Budget allocations were based on weighted rankings. The potential components of a national groundwater protection strategy are defined. The primary focus of the NCGWR is anticipatory research to identify long-term problems and needs specifically in the areas of transport and fate of pollutants, subsurface characterization, and development of equipment and technology for drilling and coring. (Geiger-FRC)
W83-02032

PROTECTING DRINKING WATER SUPPLIES THROUGH WATERSHED MANAGEMENT. A GUIDEBOOK FOR DEVISING LOCAL PROGRAMS,
North Carolina Univ. at Chapel Hill. Center for Urban and Regional Studies.
R. J. Burby, E. J. Kaiser, T. L. Miller, and D. H. Moreau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167858, Price codes: A14 in paper copy, A01 in microfiche. Report, August 1982. 323 p, 7 Fig, 31 Tab, 193 Ref, 1 Append. OWRT C-00047-U(0509)(1).

Descriptors: *Watershed management, *Water pollution control, *Land use, *Urban areas, *Drinking water, Land acquistion, Regulations, Taxes, Water pollution sources, Policy, Legal aspects.

In the past, protection of water supply sources relied on the concept of source isolation through purchase of the surrounding area. This practice is no longer practical, particularly in aeas where urban development pressures are accelerating. As a result, water supply systems and local governments must devise watershed strategies which incorporate a variety of measures and institutional arrangements to protect raw water supplies from contamination. Careful investigation of existing and potential land use activities in the watershed, and their potential for pollution, is one of the best means of assessing the risks development poses for drinking water. Once threats to water supplies have been determined, there are a variety of methods that may be used to manage watesheds. Land use planning measures are designed to reduce the susceptibility to harm from pollution by affecting the type and location of human activities occurring in the watershed. Regulations, capital improvements, land acquisition, and preferential taxation can be used to guide urban growth. A second critical aspect of watershed management programs is control over the characteristics of site development allowed in the watershed so as to minimize the generation and transport of various pollutants. Before any given combination of land use and site-level measures is adopted, it should be evaluated in terms of policy framework which sets overall agency goals, hoped for equity, efficiency, and feasibility characteristics of the management program, and principles and standards for developmnet and use of the watershed. Finally, it is important to continuously reassess management efforts to ensure that they are having their intended effects. (Moore-SRC)
W83-02055

EFFECTS OF RELEASES OF SEDIMENT FROM RESERVOIRS ON STREAM BIOTA,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
For primary bibliographic entry see Field 5C.
W83-02061

DEVELOPMENT AND APPLICATION OF MODELS FOR ANALYZING WATER RESOURCE USE AND DEVELOPMENT WITHIN A REGIONAL FRAMEWORK OF ECONOMIC GROWTH AND ENVIRONMENTAL QUALITY,
Iowa State Water Resources Research Inst., Ames.
J. F. Timmons.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167932, Price codes: A05 in paper copy, A01 in microfiche. Publication No ISWRRI-70, December 1982. 71 p, 7 Ref. OWRT B-037-IA(2) and B-042-IA(2), 14-31-0001-3887, 14-31-0001-3957.

Descriptors: Non-point pollution sources, Economics, *Iowa, *Erosion control, Model studies, Water policy, Water quality, Land use management, Soil erosion.

Soil sediment and associated materials from agricultural sectors were indicated to be one of the principle substances in determining the water quality. Phosphorus compounds and pesticides were shown to be pollutants associated with sediments. Taxation or effluent charges are discussed as policy instruments for maximizing water quality in the control of point sources of pollutants. However, treatment standards rather than taxation on charges were shown to be more effective in the control of diffused sources, such as agricultural practices. Regional control by some form of basin-wide authority was shown to be best for achieving and maintaining quality levels as inherent components or water quality management. Responsibilities of this authority should include the establishment of comprehensive land use policy, which can specify alternative means for controlling soil erosion at the source. To secure an optimal allocation of water quality over time, it may be necessary to specify water quality rights in terms of a tenure contract between the public representative and the land user.
W83-02063

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

THE POLICY DELPHI AND PUBLIC INVOLVEMENT PROGRAMS,
Planning and Management Consultants Ltd., Carbondale, IL.
N. Baumann, O. Ervin, and G. Reynolds.
Water Resources Research, Vol 18, No 4, p 721-728, August 1982, 4 Tab, 21 Ref.

Descriptors: *Planning, *Public participation, Water resources development, *Delphi Method, Policy Delphi, Cahokia Canal, *Illinois, Water policy, Flood control, Sediment control, Environmental quality, Recreation, Alternative planning.

The Policy Delphi, a derivative of the Delphi Method for eliciting expert opinion for planning purposes, was part of the public involvement program in a U. S. Army Corps of Engineers flood control project, the Cahokia Canal on the Mississippi River in Illinois. The Policy Delphi, as compared to conventional Delphi, is less oriented toward the long-range future, uses informed panelists rather than experts, identities conflict as well as consensus, and emphasizes discovery and articulation of policy alternatives and options. A panel of 33 persons was chosen, based on reputation, area representation, interest representation, and availability. The Policy Delphi proved to be a useful technique in acquiring informed opinion about the water resources issues and alternatives. Of the seven problems considered by the panelists, sedimentation was considered most serious, followed closely by environmental quality, flooding, and recreation opportunity. Erosion and water quality were considered much less important than the other problems. Subsequently, alternative courses of action were evaluated and the areas of agreement and disagreement identified. The Policy Delphi, which used individual interviews and questionaires, avoided the problems of face-to-face conflict and dominant personalities commonly encountered in committee meetings. Results from the Policy Delphi in this case could have been improved by using a somewhat larger panel, further iteration with feedback and interspersed information, and requiring panelists to elaborate on reasons for choices. (Cassar-FRC)
W83-01761

A FINANCIAL ASSESSMENT OF VIRGINIA'S OUTDOOR RECREATION PLANNING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W83-01803

VERIFICATION OF WATER QUALITY MODELS,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
R. V. Thomann.

Descriptors: *Water quality, *Model studies, Eutrophication, Lakes, Calibration, *Verification, Water quality control, Environmental protection, Decision making, *Lake Ontario.

The basic concepts of water quality models are reviewed, and the need to recognize calibration and verification of models with observed data is stressed. Post-auditing of models after environmental control procedures are implemented is needed to determine true model prediction ability. The direct questions in the decision-making arena related to model credibility are examined by several quantitative measures of model performance: regression analysis between observed and computed values, relative and root mean square errors and comparison of means. An analysis of 15 DO water quality models indicated median relative error of 10%. For a eutrophication model of Lake Ontario, application of quantitative verification measures indicated that the credibility of the calculations decreased as the model was applied to smaller

scale phenomena. Inclusion of more complex kinetics reduced median relative error across five variables and over a 10 year modeling framework from 32% to 22%. It is suggested that quantitative measures of water quality model credibility be integrated into the modeling analysis whenever possible. (Baker-FRC)
W83-01947

6B. Evaluation Process

A FINANCIAL ASSESSMENT OF VIRGINIA'S OUTDOOR RECREATION PLANNING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman, and R. Ostrander.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154468, Price codes: A03 in paper copy, A01 in microfiche. Virginia Water Resources Research Center Bulletin 136, Blacksburg, August 1982. 42 p, 1 Fig, 10 Tab, 18 Ref. OWRT A-089-VA(2).

Descriptors: *Recreation, *Outdoor recreation, *Recreation planning, *Land use, *Public investment, *Linear programming, *Virginia, Alternative planning, Costs, Budget constraints, User fees.

In recent years, large public budgets for recreation have encouraged state agencies to develop planning tools that can yield more effective spending decisions. Such tools are used to project future recreation participation and the capacity of recreation facilities for specific activities. A recreation facility need is said to exist when projected participation exceeds current capacity. Once needs are identified, expenditures for recreation development can be directed to priority needs. However, since funds available for recreation development are limited, all identified facility needs may not be met. This study was guided by two principal questions: (1) Are current recreation planning standards in Virginia realistic, i.e., can currently specified recreation needs be met within expected budget constraints. (2) What additional revenue sources might be developed to support recreation development. The study used a linear programming model to reach the conclusion that the state's recreation planning procedures are not realistic since its expressed future recreation needs cannot be met within projected budget constraints. It recommends revising current recreation planning practices and suggests that the state obtain additional revenue to meet the recreation needs by user fees combined with increased general tax revenues.
W83-01803

WATER SYSTEM REHABILITATION WAS A TIMELY INVESTMENT,
W. Eakins.
Public Works, Vol 113, No 10, p 44-47, October, 1982. 1 Fig, 2 Tab.

Descriptors: *Rehabilitation, *Water pressure, *Firefighting, Water distribution, Lynn, *Massachusetts, Water mains, Cleaning, Linings, Capacity, Water demand, Water supply.

The City of Lynn, Massachusetts, water system was able to deliver 50 million gallons of water during the 15-hour conflagration on November 18, 1981, which destroyed or damaged 26 industrial buildings. Fortunately, the old cast iron pipes, installed before 1892, had been cleaned and lined as part of a rehabilitation program implemented in the 1970's. Computer analysis after the fire indicated that the extraordinary demands of firefighting, 40,000 gpm, could not have been met if cleaning and lining had not been undertaken. Required pressures on the unrehabilitated system would have been extremely negative at the 7 junctions in the fire area. (Cassar-FRC)
W83-01835

MEASURING EFFECTIVENESS OF INFILTRATION/INFLOW REMOVAL,
RJN Environmental Associates, Inc., Wheaton, IL.
R. E. Nelson, and R. L. Bodner.
Public Works, Vol 113, No 10, p 50-52, October, 1982. 2 Fig, 2 Tab, 3 Ref.

Descriptors: *Sewer infiltration, *Economic evaluation, *Rehabilitation, Infiltration, Rate of return, Wastewater collection, *Illinois, Wheaton.

A suggested guide for economic evaluation of infiltration/inflow (I/I) removal includes annual costs and I/I removal costs. These values, determined before and after sewer rehabilitation, produce the annual savings and % return on investment. Infiltration determination methods currently in use are not very accurate. However, inflow may be determined by establishing a relation between measured inflow and rainfall intensity during partial pipe flow and then estimating peak flow for any storm frequency. The monitoring and evaluation procedure is illustrated with two case studies, Streamwood and the Arrowhead subdivision of Wheaton, both in Illinois. Annual costs for the Arrowhead sewer system were $31,698 before rehabilitation and $18,357 after rehabilitation, for a return on investment of 13.5%. (Cassar-FRC)
W83-01836

SELECTION OF OPTIMUM STORM FREQUENCY FOR SEWER STUDIES,
RJN Environmental Associates, Inc., Wheaton, IL.
R. J. Nogaj, and G. A. Braam.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1401-1497, October, 1982. 5 Fig, 4 Tab, 2 Ref.

Descriptors: *Frequency analysis, *Cost analysis, *Storm sewers, Storm drains, Municipal sewage, Storms, Storm wastewater, Storm-overflow sewers, Design criteria.

A marginal cost technique is presented which can be used in studies of sanitary sewer systems to develop a rational cost-effective rehabilitation program. Selection of an optimum storm frequency allows for proper sizing and location of relief sewer lines and also for rational sizing of wet weather treatment facilities. The technique provides a basis for developing the cost to reduce sanitary sewer backups, treatment plant bypasses, and other local water pollution effects associated with a storm event. The technique is important for estimating the probability of system overloading during an intense storm event. It also provides a mathematical basis for refuting the notion that sanitary sewer backups, surcharging and treatment plant overloads can be eliminated simply by sewer system rehabilitation without regard to storm frequency. It is noted that the level of storm protection is generally independent of the level of percent inflow removal that would be obtained through a sanitary sewer rehabilitation program. The optimum level of storm protection is related to the size of the sanitary sewer system. The optimum storm protection for a sanitary sewer system is not related to the storm event used for the design of the storm sewer system. (Baker-FRC)
W83-01934

ECONOMIC ANALYSIS OF REHABILITATION OF WATER MAINS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 296-308, October, 1982. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Water mains, *Rehabilitation, *Economic analysis, Pipes, Water distribution, Linings, Pumping head, Carrying capacity, Pipe flow, Cost-benefit analysis, Benefits, Cleaning, Costs, Energy loss, Friction.

A method for determining the cost effectiveness of water transmission line rehabilitation is developed. The decision to clean and line a pipe depends on the rehabilitation costs, the price of energy, the incremental cost of pumping capacity, the peak and average flow in the pipe, the normal diameter, the interest rate, the year in which the pumping equipment will be upgraded or replaced, and the Hazen-Williams C factor before and after rehabilitation. This method is appropriate for linens fed directly from pumps but not for small distribution lines sized for fire flow and being fed from storage tanks. Examples are given for two cases: (1) flow is not significantly changed by pipe rehabilitation, and (2) flow changes significantly because the system is looped to the extent that a change in carrying capacity affects flow. A sensitivity analysis is graphically presented to show the effects of different variables on the decision to rehabilitate a pipe. The following factors favor rehabilitation: low rehabilitation costs, high energy costs, high flows (greater frictional losses), high change in pump cost per foot head loss, large pipe diameter, and a more highly looped system. (Cassar-FRC)
W83-01937

DEVELOPMENT AND APPLICATION OF ALLOCATION CRITERIA FOR WATER USES AND USERS IN MAXIMIZING VALUE PRODUCTIVITY OF WATER SUPPLIES,
Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 3F.
W83-01953

INSTITUTIONAL ISSUES AFFECTING WATER SUPPLY DEVELOPMENT: ILLUSTRATIONS FROM SOUTHEASTERN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. E. Cox, and L. A. Shabman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167940, Price codes: A09 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Completion Report, August 1982. 189 p, 15 Tab. OWRT A-076-VA(4).

Descriptors: *Municipal water supply, *Institutional constraints, Environmental protection, Economic analysis, *Virginia, *Interbasin transfer, Groundwater development, Water law, Administrative permitting, Water conservation, Interjurisdictional conflict, *Interstate conflict, Water resources planning, Riparian rights, Natural flow doctrine, Water resources development, Future planning, Projected planning, Water allocation policy, Interjurisdictional transfer.

This report focuses on the area south of Hampton Roads, Virginia (cities of Norfolk, Suffolk, Chesapeake, Virginia Beach) as a case study of the water supply development process. Recent droughts have emphasized limitations on existing supplies and heightened awareness of the need to expand them. Several plans have been proposed but have met with strong opposition. In the absence of a regional solution, several localities have acted independently to expand their own supplies. This report provides background information on (1) institutional considerations affecting choice of a particular plan and (2) relative costs of the available supply management options. The institutional analysis addresses existing laws and administrative programs for water resources planning and development, water rights, issues, and legislative and administrative constraints on water supply development. Cost analyses are presented for different combinations of surface water development, groundwater development, system interconnection, and demand management. Impacts of institutional factors on the alternative managment stategies are evaluated. The report concludes that the least-cost strategy for expanding water supplies in the study area is a combination of the alternatives implemented in a phased approach rather than any single development action. Institutional issues are a major factor in the selection of a management strategy. In the event that an institutional constraint results in the selection of a more costly rather than a less costly alternative, the additional expenditure represents a cost attributable to the maintenance of the responsible institutional constraint. Thus, the water supply planning process provides an ongoing assessment of the existing institutional framework. This study raises questions concerning the adequacy of Virginia's existing institutional structure for water supply decision

making and concludes that re-evaluation of the traditional, decentralized approach is needed.
W83-02064

THE POTENTIAL ROLE FOR WATER RESOURCES RESEARCH IN THE DEVELOPMENT OF A STATE WATER RESOURCES PLANNING PROCESS IN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman, and W. E. Cox.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167957, Price codes: A07 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Completion Report, January 1983. 138 p, 4 Fig, 72 Ref. OWRT A-095-VA(1).

Descriptors: *Water resources planning, Planning, Water resources management, Water resources development, Decision making, *Future planning, Projected planning, Urban planning, *State planning process, Planning process, Water policy, Conflict management, *Research priorities, *Water research, Water supply, Water quantity, Water allocation, *Virginia, York River Basin.

This report reviews and describes the concepts behind and the planning for water resources management in the United States, with examples from Virginia, California, Illinois, Nebraska, New York, Oregon, Utah, Washington, Wyoming, and Georgia. It describes the current trend in the states away from traditional planning, which focuses on comprehensive plan development, to a problem-focused planning, which stresses the management of interest-group conflict and negotiation. Based on the evaluation of alternative approaches to state water planning as displayed by the states used as examples, the report makes specific recommendations to facilitate the implementation of Virgina's 1982 statutory mandate to develop a water management plan for the state. A literature review and interviews with persons knowledgeable about water resources planning in Virginia and other states were conducted and are integrated into the report in narrative form. The report identifies key components of a state water planning process; discusses state water planning as it has evolved since 1965; summarizes Virginia's water resources problems, using the York River Basin as a case illustration; suggests strategies for implementing water planning authority in Virginia; and recommends research priorities to support a planning process in Virginia (research on policy, conflict management strategies, and analytical tools for framework and appraisal planning). Specific research needs are noted for each of the three main areas.
W83-02065

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

SUMMARY: SYMPOSIUM ON INLAND WATERWAY USER CHARGES, CAPITAL RECOVERY COST ISSUES, AND THEIR RELATIONSHIP TO NATIONAL TRANSPORTATION POLICY,
L. E. Haefner, and W. Dye.
Transportation Research Record, Vol 825, p 17-18, 1981.

Descriptors: *Inland waterways, *Transportation, *User charges, Water management, *Policy making, *Symposium, Cost allocation, Cost analysis, Navigable rivers, Navigation, Water costs, Water policy, Data collections, Capital.

In July of 1978, the Committee on Inland Waterways of the Transportation Research Board conducted a symposium on inland waterway user charges and their relationship to national transportation policy. Opinions on user charges differed substantially among different interest groups. The U.S. Army Corps of Engineers is charged with the operation, maintenance, and construction of navigation and flood control projects on inland waterway systems. The Corps maintains an on-line data collection and analysis program called the Inland Navigation Systems Analysis (INSA) program which provides a data base for modeling projections and analyzing the operation, maintenance, and expansion of the waterway system on a one-month delay basis. The INSA program has established a multimodal allocation model that uses commodity flows and performs an allocation to the various transportation modes. Two other models involve allocations of commodity movements and determine the effects of technological and structural changes on the waterway fleet. Water carriers maintain that barge transport is more energy efficient than rail transport and that user charges are weighted unfairly. Waterway operators also oppose the imposition of user charges involving intermodal diversion or competition. Railway operators argue that maintenance of inland waterways is subsidized by taxpayers. A senate committee spokesman advocated a percentage of recovery as necessary for a rational subsidy program for the inland waterway system, while a Department of Transportation spokesman advocated a cost-recovery user charge in the absence of some overriding social objectives or significant non-user benefits. It is hoped that data from the Corps of Engineers will provide a basis for policymaking regarding user charges for inland waterways. (Geiger-FRC)
W83-01806

WATER DISTRIBUTION SYSTEMS: A SPATIAL AND COST EVALUATION,
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W83-01936

COST ESTIMATING FOR CONVENTIONAL WATER TREATMENT,
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W83-01940

THE IMPACT OF WATER SYSTEM PRICING ON CONSUMPTION AND CONSERVATION,
Mississippi Univ., University. Bureau of Business and Economic Research.
For primary bibliographic entry see Field 3D.
W83-02062

6D. Water Demand

TREAT THE WELLS WITH CAUTION,
D. Cuzovic.
Aqua, No 5, p 31-32, 1982.

Descriptors: *Water supply, *Water management, *Municipal water, Groundwater management, Belgrade, *Yugoslavia, Wells, Water policy, Water demand.

The city of Belgrade, which extracts all but 7% of its water from groundwater wells, has nearly reached the limit of available supplies from this source. Costs of additional wells at distant sources are high, and some of the newly drilled wells drain water tables already supplying water to the system. Use of river water as a municipal supply is very unpopular among the consumers. However, policies must be changed to incorporate the use of river water in the management scheme. (Cassar-FRC)
W83-01813

HIGH PLAINS LOW ON WATER.
World Water, Vol 5, No 9, p 17-19, 23, 25, September, 1982. 3 Fig.

Descriptors: *Water transport, *Water supply, Water resources development, Groundwater supplies, Water demand, Irrigation, Water shortage, *Ogallala aquifer, Aquifers, Groundwater management, *High Plains area.

Water is being drawn from the Ogallala Aquifer faster than it is being replenished. The Ogallala is the chief source of supply for irrigation water throughout the High Plains area, which includes parts of six states. Irrigation demands account for 90% of the fresh water used in the High Plains. Alongside the agricultural boom has come a rapid expansion of associated businesses supplying finance, pumps, pipes, sprinklers, fertilizers, pesticides, processing plants, and farm equipment. The Corps of Engineers was instructed to look at ways of importing extra water supplies to the High Plains, and the Commerce Secretary to come up with a plan for allocating and distributing water equitably if such transfers were to be part of a reasonable solution. Comprehensive plans were produced by the Corps for major transfers, presuming availability of the necessary amount of water from neighboring states. The analyses showed benefits from water transfer schemes. However, the report went on to demonstrate that groundwater depletion would continue during the study period, and that import volumes would have to increase after the year 2020 unless land were to be lost to irrigation at that time. (Baker-FRC)
W83-01820

RELATIVE IMPORTANCE OF GROUNDWATER AND SURFACE-WATER SUPPLIES TO OIL-SHALE DEVELOPMENT, PICEANCE BASIN, COLORADO,
Geological Survey, Reston, VA. Water Resources Div.
W. M. Alley.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $6.50 in paper copy, $3.50 in microfiche. Geological Survey, Open-File Report 82-340, 1982. 46 p, 14 Fig, 2 Tab, 28 Ref.

Descriptors: *Groundwater, *Surface water, *Oil shale, *Water resources development, Surface-groundwater relations, Water use, Model studies, Synethetic hydrology, *Colorado, Colorado River basin, Piceance basin.

A sensitivity analysis was perfomed of the required active storage capacity (VMAX) of a hypothetical reservoir on the White River to different assumptions about water demands for oil-shale development and the contributions from various sources of water. Estimates of VMAX were found to be sensitive to estimates of the supply of water available from the oil-shale aquifers. For example, the current estimate of average natural recharge to the oil-shale aquifers is approximately equal to the amount of water required by an oil-shale industry producing 250,000 barrels of oil per day and requiring 3 barrels of water per barrel of shale-oil produced. Estimates of VMAX were also sensitive to estimates of the supply of water available from the Colorado River and the requirements for downstream releases on the White River. The sensitivity of VMAX to use of water from the four main streams in the Piceance basin (Parachute, Roan, Piceance, and Yellow Creeks) was less than its sensitivity to these factors. Compared to the uncertainty in other factors, water-supply estimates are shown to be insensitive to uncertainty in evaporation estimates. A transient analysis was performed using a synthetic streamflow model to generate 500 equally likely periods of monthly inflows to the hypothetical reservoir. An oil-shale industry was assumed to expand from 0 to 1 million barrels of oil per day over a 30-year time period, and mine water was assumed to be available at an increasing rate that averaged one-half the current estimated natural recharge rate to the Piceance basin. Use of this mine water to supply part of the water demand resulted in reductions in surface-storage requirements (VMAX) on the order of 15-20 thousand acre-ft over many of the 500 streamflow sequences. (USGS)
W83-01854

A SYSTEM FOR MEASURING PUBLIC USE OF ROSS BARNETT RESERVOIR DISTRICT,
University of Southern Mississippi, Hattiesburg. Dept. of Recreation.
W. H. Bumgardner, and C. Burchell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-168013, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, Mississippi State Univ., Mississippi State, December 1982. 57 p, 13 Tab, 11 Ref, 3 Append. OWRT B-024-MS(1), 14-34-0001-0227.

Descriptors: *Reservoirs, Reservoir operation, *Recreation, *Recreation demand, *Recreation facilities, Public access, Parks, Public participation, Social participation, Water management, *Mississippi, Ross Barnett Reservoir district.

The objective of this study was to develop a system for measuring (estimating) public use of Ross Barnett Reservoir District which is located near Jackson, Mississippi. Surveillance of visitation and usage during the recreation seasons comprising the summers of 1980 and 1981 enabled the identification of all significant points of access to the reservoir. An integrated estimation system, employing the use of traffic counters, camper registrations, infrared counting devices, and activity timelogs, has been designed and recommended for use by the Pearl River Valley Water Supply District. Supplemental data, procedural guidelines and a computer program have been developed for operationalizing the system. The system was designed in a manner that accounts for unique characteristics of the reservoir district such as multiple and, in some instances, uncontrolled access as well as reservoir usage by a large onsite residential population.
W83-02071

HYDROPOWER FINDS NEW MARKET IN THE THIRD WORLD,
Journal of Commerce, New York.
L. Ioannou.
Civil Engineering (New York), Vol 52, No 10, p 51-55, October, 1982.

Descriptors: *Water resources development, *Hydroelectric plants, *Hydroelectric power, Electric power, Electric power production, Powerplant, Asia, Argentina, China, United States, Pakistan, Philippines, India, Third World Countries, Nigeria, Energy sources.

The attractions of hydropower as an inexpensive, non-polluting, sustainable source of energy seem to be making hydro a booming field in the Third World. The nature of the hydropower market and its potential for growth have influenced some markets to restructure in order to compete. Work in China, the Philipines, Pakistan and various locations in Asia is cited. One project in Argentina has as one of its purposes the attraction of settlement to the area. The project, Casa de Piedra, is near Neuquen on the Colorado River, where its generating capacity will be 230 megawatts. (Baker-FRC)
W83-02095

6E. Water Law and Institutions

INTERSTATE WATER PROBLEMS CONCERNING THE ESCATAWPA RIVER--THE NEED FOR JOINT DEVELOPMENT BY ALABAMA AND MISSISSIPPI,
Alabama Univ., University. School of Law.
H. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-154427, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report, March 1982, Auburn, Alabama. 29 p. OWRT A-082-ALA(1), 14-34-0001-1101.

Descriptors: Legal aspects, *Riparian rights, *State jurisdiction, *Water law, *Water rights, Riparian waters, River flow, *Alabama, *Mississippi, *Interstate rivers, Interstate compacts, *Escatawpa River.

The Escatawpa River flows from Alabama into Mississippi and joins the Pascagoula River near the Mississippi Sound. Because of the need for fresh water in Jackson County, Mississippi, the Escatawpa River is an important resource. Mississippi authorities argue that Mobile has taken unusually large quantities of the Escatawpa River, depriving Jackson of its rights in the river. Alabama authorities state unequivocally that no water has ever been taken from the river by the Mobile Water Service System. This report constitutes an effort to seek legal answers to the problems raised by these facts. Litigation between the two states should only be utilized after all other attempts to settle the dispute have failed. An Interstate Compact resulting from negotiation involving the legislatures of both states is a starting point. However, the seriousness of the difficulties by water users in the two states is not at a high-tempered stage; therefore such high-level negotiation at this time is unlikely.
W83-01796

HOW MUCH WATER CLEAN-UP DO WE WANT TO PURCHASE,
Mississippi State Univ., Mississippi State. Div. of Business Research.
For primary bibliographic entry see Field 5D.
W83-01842

LEGAL IMPLICATIONS OF COASTAL EROSION IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Sea Grant Legal Program.
P. Hribernick, and M. Wascom.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 128-139, 51 Ref.

Descriptors: *Erosion, *Land tenure, *Legal aspects,*Riparian rights, *Louisiana, Land reclamation, Coastal waters, Littoral zone.

Erosion in the coastal zone of Louisiana has serious legal consequences for all property owners. When a Louisiana private property owner's lands are subjected to erosion, the land owner is placed in an adversarial position with the State. If the private property abuts a navigable river, the riparian loses to the state any property which erodes, but gains ownership of any alluvion that builds up along his river bank. If the private property abuts a navigable lake or the coastline, the littoral owner is placed in a 'no win' situation. Any portion of his land which erodes is lost to the state and ownership of any new land created between his property line and the water vests in the State, cutting the littoral owner off from the water by a strip of state-owned land. However, State law generally allows the private land-owner to reclaim any land lost to erosion. When the State's coastline is subjected to erosion, the State is placed in an adversarial position with the Federal Government. As erosion forces the coastline landward, the State's territorial sea theoretically moves a corresponding distance landward. Unlike the private landowner, the Federal Government does not give the State a chance to reclaim lands lost to erosion. As a result, Louisiana may ultimately lose valuable offshore mineral rights to the Federal government if the courts are ever asked to recompute the State's coastline which is the baseline for measurement of the territorial sea. (Moore-SRC)
W83-01868

WATER RESOURCES MANAGEMENT: A DESCRIPTION OF COMPREHENSIVE MANAGEMENT SYSTEMS IN THE STATES AND FUTURE RESEARCH NEEDS,
Old Dominion Univ., Norfolk, VA. Dept. of Urban Studies and Public Administration.
W. A. Gibson, and L. I. Ruchelman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167544, Price codes: A10 in paper copy, A01 in microfiche. Virginia Water Resources Research Center Completion Report, Virginia Polytechnic Institute and State University, Blacksburg, October, 1982, Vols I and II. 203 p, 10 Fig, 11 Tab, 3 Append, 35 Footnotes. OWRT A-096-VA(1,2).

Descriptors: *Water resources management, *Water law, Water management, *Comprehensive planning, Reparian law, *Florida, *Georgia, *New Jersey, State governments, Future planning, Regulations, *State juridiction, Legal aspects, Administration, Research needs, Research priorities.

Water resources management on the state level reflects both environmental conditions and the institutional-legal structure. As new water needs develop, state government strives to modify existing procedures to meet these needs. Such change usually comes about incrementally rather than through broad-scale, rapid transformation. This general pattern was observed in this study of water resource management in Florida, Georgia, and New Jersey, three riparian-law states that have been especially innovative. Each state tends to map out a different approach to its water problems. The three states are viewed as representing different water management models. Florida represents the federalist-regulatory model, Georgia represents the unified-regulatory model, and New Jersey represents the home-rule/strong planning model. Each of these models is examined for its particular advantages, which should be weighed when being considered for adoption in other settings. Each of the states is also assessed as to the extent to which they address certain critical areas of water management. This allows for comparison of planning and regulatory comprehensiveness. Such data can then be used as baseline information to assess other states and to identify possible gaps in water resource management.
W83-01951

NEW CHALLENGES IN THE GREAT LAKE STATES TO BANNING PHOSPHORUS IN DETERGENTS,
For primary bibliographic entry see Field 5G.
W83-01967

NPDES RULES FOR INDUSTRIAL DISCHARGERS: NEW OBLIGATIONS, NEW OPPORTUNITIES,
Smith and Schnacke, Dayton, OH.
For primary bibliographic entry see Field 5G.
W83-01968

AN ANALYSIS OF TWO PRINCIPLE LEGAL/INSTITUTIONAL CONSTRAINTS TO AGRICULTURAL WATER CONSERVATION IN THE ELEVEN WESTERN STATES.
Teknekron Research, Inc., Berkeley, CA. Industrial Planning Div.
For primary bibliographic entry see Field 3F.
W83-02051

INSTITUTIONAL ISSUES AFFECTING WATER SUPPLY DEVELOPMENT: ILLUSTRATIONS FROM SOUTHEASTERN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W83-02064

THE POTENTIAL ROLE FOR WATER RESOURCES RESEARCH IN THE DEVELOPMENT OF A STATE WATER RESOURCES PLANNING PROCESS IN VIRGINIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W83-02065

6F. Nonstructural Alternatives

WHO IS KILLING THE RHINE,
For primary bibliographic entry see Field 5G.
W83-01838

WATER RESOURCES AND GROWTH MANAGEMENT IN SOUTH FLORIDA,
Hole, Montes and Associates, Inc., Naples, FL.
S. W. Hole, and P. B. Rhoads.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 286-295, October, 1982. 2 Fig, 4 Ref.

Descriptors: *Water management, *Land development, *Growth, Management, Water resources development, Land management, Groundwater management, Resources management, *Florida, Land

use planning, Drainage, Zoning, Nonstructural alternatives, Planning, Urban planning, Regional planning, Decision making, Local governments, Wetlands, Surface water, Permits Water use, Water allocation, Drought, Flood control.

Water resources management in Southeast Florida is closely related to land development. Complex problems pose difficulties for water managers--54-60 inches of average annual rainfall with extremes from 35 to 100 inches, a May-October wet season during which 70% of rainfll occurs, flat topography, high evapotranspiration, salt water intrusion of aquifers, and sensitive wetland ecosystem. The South Florida Water Management District, created in 1972, has comprehensive water management functions for the 18,000 sq mi area. It must maintain a balance in growth so that essential services can be provided at a reasonable cost and natural resources are not intolerably affected. Water use is regulated by a program requiring permits for all withdrawals in excess of 100,000 gpd. Applicants must show a reasonable-beneficial use, not interfering with a present use and consistent with public interest. Resource availability per se is not a constraint on long-term growth in this region, but water utilities are struggling to keep up with demand. Moratoria on connection serve as a control on building and development. Surface water management is closely related to development. Zoning restricts the type of building for land parcels to minimize flood damage to homes, prevent damage to the environment, and maintain the land area necessary for water management purposes. This management has had little effect on intensity or magnitude of growth but a moderate effect on distribution and timing. During the past decade the District has supported local government growth management efforts by coordinating plans and regulations and by providing help in decision making. (Cassar-FRC)
W83-01895

SEASONAL TREATMENT AND VARIABLE EFFLUENT QUALITY BASED ON ASSIMILATIVE CAPACITY,
Stanley Consultants, Inc., Atlanta, GA.
M. C. Boner, and L. P. Furland.
Journal of the Water Pollution Control Federation, Vol 54, No 10, p 1408-1416, October, 1982. 11 Fig, 5 Tab.

Descriptors: *Waste assimilative capacity, *Wastewater treatment, *Water quality, *Seasonal variations, Streams, Rivers, Cost analysis, Financial aspects, Nitrification, Water treatment facilities, *Georgia, Water pollution control, Water resources development.

Increasing pollution control costs and associated energy consumption are beginning to direct attention toward more effective use of resources. Seasonal nitrification permitting, as proposed in Georgia by the EPA, is the first step leading to more effective use of assimilative capacity of receiving streams. The use of stream assimilative capacity may eventually progress to the point of regional economic assignments of treatment responsibility. For example, the cost to cool all or a portion of the thermal discharge on a seasonal basis might be studied and compared to the cost to provide higher levels of wastewater treatment in Atlanta and other municipalities in order to determine the lowest total cost system for the region. There may be cost savings resulting from economies of scale if various treatment levels are assigned to the different wastewater treatment facilities. The overall economic optimization of effluent cooling and effluent treatment on a seasonal basis would require governmental and industry cooperation and possibly financial transfers. With the ability to regulate flows in streams and with calibrated modeling capabilities, optimizing wastewater treatment economics to make better use of available stream assimilative capacity should be considered. (Baker-FRC)
W83-01935

MANAGEMENT SCHEME FOR DEVILS LAKE BASIN WETLANDS,
North Dakota State Univ., Fargo.
For primary bibliographic entry see Field 4A.
W83-02050

PROTECTING DRINKING WATER SUPPLIES THROUGH WATERSHED MANAGEMENT. A GUIDEBOOK FOR DEVISING LOCAL PROGRAMS,
North Carolina Univ. at Chapel Hill. Center for Urban and Regional Studies.
For primary bibliographic entry see Field 5G.
W83-02055

6G. Ecologic Impact Of Water Development

CONVERTING AN ESTUARY TO LAKE GREVELINGEN: ENVIRONMENTAL REVIEW OF A COASTAL ENGINEERING PROJECT,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
H. L. F. Saeijs, and P. B. M. Stortelder.
Environmental Management, Vol 6, No 5, p 377-405, September, 1982. 22 Fig, 14 Tab, 33 Ref.

Descriptors: Water resources development, *Estuaries, *Flood protection, Flood control, Storms, Lake Grevelingen, Dams, Barriers, Lakes, Storm surges, Surges, *Netherlands, Environmental effects, Chlorides, Phosphates.

In order to guarantee protection from storm floods in the southwestern part of the Netherlands, the length of exposed coastline is being greatly reduced by the construction of dams and a storm surge barrier. As part of the Delta Project, the mouth of the Grevelingen estuary was closed in 1971. Due to the closure, tidal movement was eliminated, resulting in changes in environmental factors such as transparency and chloride and phosphate concentration. The number of plant and animal groups decreased. Large areas of sand flats and salt marshes which were formerly exposed to the tides were left high and dry. This caused enormous change for the biological communities living in these areas. The demand for recreational facilities and nature conservation and the need for a balanced realization of these main functions were explored. Water quality and ecosystem management were important parts of the program planning. One of the major concerns is to prevent further decrease in the chloride concentration and the number of species. A sluice was therefore put into operation in 1978, by means of which water was exchanged between the North Sea and Lake Grevelingen. The question of whether Lake Grevelingen will remain a salt water lake or become a fresh water lake will have to be decided in the future. (Baker-FRC)
W83-01784

THE JONGLEI CANAL--NEEDED DEVELOPMENT OR POTENTIAL ECODISASTER.,
Khartoum Univ. (Sudan). Inst. of Environmental Studies.
A. I. Moghraby.
Environmental Conservation, Vol 9, No 2, p 141-148, Summer, 1982. 4 Fig, 15 Ref.

Descriptors: *Diversion channels, *Swamps, *Canal construction, *Environmental effects, Water resources development, Evaporation, *Jonglei Canal, *Sudan, *Nile River, Sudd, Wetlands, Aquatic plants, Plankton, Wildlife, Fish, Irrigation water.

The author advocates implementation of Phase 1, but not Phase 2, of the Jonglei Canal, currently under construction in the Sudan to supply water during the dry season to regions downstream on the Nile River. The Phase 1 construction of the 20 million cu m per day capacity, 360 km long, 52 m wide, 4 m deep canal from Bor to the mouth of the Sobat River, would desiccate 10-15% of the present area of the Sudd, the 6,000 to 100,000 sq km (according to season) almost impassable swamp in this region. Phase 2, which would increase the capacity of the canal to 43 million cu m per day, use the equatorial lakes for storage, and improve other channels, would completely dry up the swamps. The Sudd is ecologically and economically important, supporting a rich flora and fauna and serving as a major gene reserve. The hydrology, physical characteristics, and ecology of the Sudd are reviewed. As water passes through the Sudd, total dissolved solids, Ca, Mg, K, and Si levels increase and Na, phosphates, and N are removed. Evaporation from this large surface is of hydrological importance. Vegetation includes many types of water plants, reeds, ferns, and woody plants. Diatoms and blue-green algae are the dominant phytoplankton. Lake zooplankton populations are destroyed in the falls before the water reaches the swamps, but rich populations develop in the fringe vegetation. Benthic flora and fauna are sparse. Of the 40 fish species, most tolerate oxygen deficient conditions and are detritus feeders. Animal wildlife, particularly crocodiles and birds, is abundant and diversified. (Cassar-FRC)
W83-01785

SALINITY-PRODUCTIVITY RELATIONSHIPS OF SELECTED PLANT SPECIES FROM THE SUISUN MARSH, CALIFORNIA,
California Univ., Davis. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W83-01802

WETLAND LOSS DIRECTLY ASSOCIATED WITH CANAL DREDGING IN THE LOUISIANA COASTAL ZONE,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
W. B. Johnson, and J. G. Gosselink.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 60-72, 5 Fig, 6 Tab, 15 Ref.

Descriptors: *Canals, *Wetlands, *Canal construction, *Spoil banks, *Berms, *Bank erosion, *Louisiana, Navigation canals, Boating, Environmental effects, Dredging.

Manmade canals are a dominant feature of the Louisiana Coast, and there is evidence that this canal network contributes significantly to wetland loss, both directly and indirectly. Direct effects are the immediate conversion of wetland to canals and spoil banks during canal construction, and the subsequent widening of canals as their banks erode. The relationship between proposed canal widths specified in dredging permit applications and the actual wetland affected was studied at oil and gas well-access canals and the Louisiana Offshore Oil Port pipeline system. The average actual width of the newly dredged canals studied exceeded the width specified in the dredging permit by 13.4 m. The total width affected, including berm and spoil deposits, exceeded the permitted canal width by an average of 81.7 m. As canals age, they widen through erosion. The history of three old canal systems in coastal Louisiana was examined. All these canals continue to increase in width, and differences in their patterns of widening can be explained by boat traffic, length of time since construction, and substrate differences. Canals in areas of greatest boat activity widened at a rate of 2.58 m/yr, while those in areas of minimal boat activity widened at a rate of 0.95 m/yr. (Moore-SRC)
W83-01865

CANALS AND WETLAND EROSION RATES IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. E. Turner, R. Costanza, and W. Scaife.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 73-84, 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Coastal marshes, *Canals, *Wetlands, *Erosion, *Louisiana, Substrates, Canal construction, Dredging, Ponds.

Canals have increased in area from practically zero at the beginning of the century to about 2.5% of the Louisiana coastal surface area in 1978. The annual increase in canal area is continuing to climb in 1981 as a result of new canal dredging and the widening of existing canals. The whole coast is not uniform with respect to canal density and land loss rates. There is general relationship between canal density and land loss rates in each hydrologic unit. The point at which canal density is zero is also where land loss rates are slightly below zero (a net gain). Land loss is high when canal densities are high. Land loss rates across the coastal zone since the 1890's, among hydrologic units, and within areas of similar substrates and equal distances to the coast are all positively related to estimates of canal density. Within 7 1/2' quadrangle maps, the new ponds in the marsh have appeared close to canals, not near natural channels. Coastwide, canal surface is about 10% of the total land loss. It is concluded that coastal erosion rates in Louisiana are largely an indirect result of canal dredging activities or use. The mechanism for the effect probably involves an alteration in wetland hydrology, but a complete understanding is presently lacking. (Moore-SRC)
W83-01866

EFFECTS OF WETLAND DETERIORATION ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,
Fish and Wildlife Service, Lafayette, LA.
D. W. Fruge.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82-59, September 1982. p 99-107, 33 Ref.

Descriptors: *Wetlands, *Wildlife habitats, *Coastal marshes,*Environmental effects, *Fisheries, Water resources development, *Louisiana, Sediments, Recreation, Channels, Drainage, Levees, Construction, Estuaries.

The vast wetlands of the Louisiana Coastal Region (LCR) are of national importance to fish and wildlife. These wetlands are winter habitat for one-fourth of the North American dabbling duck population, a large portion of the Mississippi Flyway's diving ducks, and over 400,000 geese. Coastal Louisiana also supports numerous other migratory birds, many of which nest in its wetlands. The LCR marshes produce the largest fur harvest in North America, and support the largest volume of estuarine-dependent fish and shellfish landings in the United States. Fish and wildlife related recreation in the LCR is also extensive, including over 5 million man-days of saltwater fishing in 1975 and 676,000 man-days of waterfowl hunting during the 1977-78 season. Prior studies documented an annual land loss rate of over 42.7 sq km (16.5 sq mi)/yr in the LCR. Most recent investigations indicate that this rate of wetland loss has more than doubled since 1956. Wetland deterioration, which is partially attributable to natural causes, has been greatly accelerated by human influences such as navigation channel excavation, agricultural drainage, and construction of mainline Mississippi River levees that have prevented freshwater and sediment overflow into adjacent subdelta marshes. Continued wetland deterioration may lead to serious declines in estuarine-dependent fish and shellfish harvest, fur catch, waterfowl habitat, and related fish and wildlife productivity. The U. S. Fish and Wildlife Service has long advocated freshwater diversion for habitat improvement in the Mississippi deltaic plain region and is participating in the evaluation of several freshwater diversion sites being investigated by the U. S. Army Corps of Engineers. It is anticipated that marsh restoration measures involving freshwater diversion and other approaches will also be financed by the State of Louisiana through its Coastal Environmental Protection Trust Fund. (Author's abstract)
W83-01867

COMPARISON OF EFFECTIVENESS OF MANAGEMENT OPTIONS FOR WETLAND LOSS IN THE COASTAL ZONE OF LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. W. Day, Jr., and N. J. Craig.
In: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, Baton Rouge, Louisiana, October 5-7, 1981, D. F. Boesch, ed., Fish and Wildlife Service Report FWS/OBS-82/59, September 1982. p 232-239, 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Wetlands, *Coastal zone managment, *Canal construction, *Diversion, *Sedimentation, *Erosion, *Louisiana, Mississippi River, Atchafalaya River, Deltas, Subsidence, Erosion, Flood control, Resource management.

The coastal wetlands of Louisiana, an area of 14,000 sq km, are currently experiencing an overall net loss of approximately 130 sq km/yr. The loss is cumulative, resulting from both natural and artificial causes. Natural causes include land subsidence, the deterioration of abandoned river deltas, and erosion by wave energy and storms. Human-induced land losses result from control practices, impoundments, and the dredging of canals and channels. The effectiveness of the following three management options was examined: management of the current land building of the Atchafalaya River; controlled diversion schemes on the lower Mississippi River; and strict regulatory control of canals within the coastal zone. Strict regulatory control of new canals could reduce future land loss rate by 30 to 40 sq km/yr. This compares with 1 to 3 sq km/yr for controlled diversion plans, and 18 sq km/yr for the land-building processes of the Atchafalaya River. The following measures are recommended to combat wetland loss: management of the Atchafalaya River for maximum land building; use of controlled diversions along the Mississippi River and strict regulatory control of canals within the Louisiana wetland system. (Moore-SRC)
W83-01870

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME I, SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES: A SUMMARY BY GEOGRAPHIC AREA,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01871

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME II, LAKE SUPERIOR,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01872

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME III, ST. MARY'S RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01873

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME IV, LAKE MICHIGAN,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01874

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME 5, LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01875

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VI, ST. CLAIR RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01876

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VII, LAKE ST. CLAIR,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01877

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VIII, DETROIT RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01878

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME IX, LAKE ERIE,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01879

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME X, NIAGARA RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01880

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XI, LAKE ONTARIO,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01881

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XII, ST. LAWRENCE RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 7C.
W83-01882

COLUMBIA RIVER TREATY: ENVIRONMENTAL IMPACT,
Army Engineer Div. North Pacific, Portland, OR.
N. A. Dodge.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR3, p 309-320, October, 1982. 9 Fig, 2 Ref.

Descriptors: *Environmental effects, *Hydroelectric power, *Fish conservation, Powerplants, *Columbia River Treaty, Canada, Treaties, International agreements, Social impact, Economic impact, Anadromous fish, Fish barriers, Fish guiding, Fish ladders, Fish management, Fish migration, Fish passages, Salmon, Dam effects, Reservoir storage, Reservoir operation, Reservoir releases, Flow augmentation, Instream flow, Recreation, Streamflow, Intakes, Minimum flow, Water storage, Water management, Benefits.

Implementation of the Columbia River Treaty (1961) has produced socioeconomic benefits and setbacks in the anadromous fishery. The treaty provides for cooperative basin management and sharing of power benefits between Canada and the U.S. Socioeconomic benefits include low-cost power, which stimulates the economy and encourages a high standard of living and reduction of major catastrophic floods. Power costs are mini-

mized by interconnecting the 16 Pacific Northwest utilities and the British Columbia Hydro and Power Authority. This coordination allows efficient use of streamflows. The filling of Mica Reservoir, initiated in 1973, was accomplished in minimum time by coordinating power generation and reservoir releases among utilities in the two countries. The salmon and steelhead fishery (current annual catch, 4-5 million fish) is low and declining. This is a result of ocean and river overfishing, poor forest and agricultural practices, elimination of headwater habitat, and dams on the river. Mitigation features include fish passages, propagation facilities, and hauling past the dam in trucks. Devices have been developed to reduce the number of juvenile fish entering the turbine intakes. A major remaining problem is the additional 15.5 million acre ft of storage developed after the Treaty. This causes reservoirs to hold back water for storage purposes, significantly reducing the spring freshet and discouraging migration to the sea. Minimum instream flow levels are proposed, but the agencies are having difficulty deciding on a program that will maintain flow without severely affecting the power system, irrigation, and recreational uses. Solutions to the problem (transmission to the Pacific Southwest in times of surplus and later retransmission and/or replacement of some power capacity with fossil fueled plants) are expensive. (Cassar-FRC)
W83-01909

ANALYSIS OF LONGITUDINAL ZONATIONATION AND THE RIVER CONTINUUM CONCEPT IN THE OLDMAN-SOUTH SASKATCHEWAN RIVER SYSTEM,
Calgary Univ. (Alberta). Dept. of Biology.
J. M. Culp, and R. W. Davies.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 9, p 1258-1266, September, 1982. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Zones, *Rivers, *Benthos, Macroinvertebrates, Forests, Prairies, Population dynamics, Watersheds, Geology, Climate, Soil type, Vegetation, Longitudinal zonation, River continuum concept, Reciprocal average ordination, *Alberta, Oldman-South Saskatchewan River system.

The benthic macroinvertebrate communities of the Oldman-South Saskatchewan River system demonstrated a longitudinal zonation related to the subalpine forest, fescue prairie, and mixed prairie terrestrial ecosystem during the summer-fall periods. This zonation was primarily attributable to significant downstream increases in periphyton biomass, plant nutrients, and water temperature. Zonation was reduced in the late winter-spring periods and absent in May, during spring runoff. Longitudinal trends in macroinvertebrate functional feeding groups generally followed the predictions of the river continuum concept, with trophic composition apparently more strongly affected by autotrophic processes in the summer, and heterotrophic processes in the winter. By combining the river continuum concept with a watershed classification system based on geology, climate, soil type, and terrestrial vegetation, it is suggested that biological comparisons of logitudinal zonation are enhanced. (Baker-FRC)
W83-02098

ECOLOGICAL RESPONSES OF HYDROPSYCHID CADDISFLIES TO STREAM REGULATION,
Montana Univ., Bigfork. Biological Station.
F. R. Hauer, and J. A. Stanford.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 9, p 1235-1242, September, 1982. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Ecosystems, *Population dynamics, *Dams, Zoobenthos, Temperature effects, Particulate organic matter, Dissolved organic matter, Rivers, Hydropsychidae, Trichoptera, Flathead River, Stream continuum, Ecological effects, Montana, British Columbia.

Based on the river continuum theory and preliminary studies made in the upper Flathead River, it was expected that a sequential change would be noted in the hydropsychid fauna from large Arctopsychinae species in low-order streams to smaller Hydropsychinae in the higher-order rivers. Prior to the construction of Hungry Horse Dam, comparatively warmer waters and availability of sestonic particulate organic matter probably favored the smaller Hydropsychinae species over A. grandis in the mainstream river above Flathead Lake. However, cold-water discharges from Hungry Hose Dam, couples with increased concentrations of particulate organic matter from Kintla Creek, actually exerted a 'reset' influence on the Flathead River continuum by eliminating net-spinning caddisflies from the South Fork below the dam and significantly favoring A. grandis over the Hydropsychinae species in the mainstream. (Baker-FRC)
W83-02100

7. RESOURCES DATA

7A. Network Design

VERIFICATION PLAN FOR HYDROLOGIC DATA,
Geological Survey, Portland, OR. Water Resources Div.
C. W. Alexander.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $3.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-374, 1982. 22 p, 5 Fig, 3 Ref.

Descriptors: *Hydrologic data, *Computers, *Data processing, *Surface water, Streamflow, Data storage and retrieval, Error analysis, Quality control, Automation, Data verification.

Data verification refers to the performance of quality control on hydrologic data that have been retrieved from the field and are being prepared for dissemination to water-data users. Water-data users now have access to computerized data files containing unpublished, unverified hydrologic data. Therefore, it is necessary to develop techniques and systems whereby the computer can perform some data-verification functions before the data are stored in user-accessible files. Computerized data-verification routines can be developed for this purpose. A single, unified concept describing master data-verification program using multiple special-purpose subroutines, and a screen file containing verification criteria, can probably be adapted to any type and size of computer-processing system. Some traditional manual-verification procedures can be adapted for computerized verification, but new procedures can also be developed that would take advantage of the powerful statistical tools and data-handling procedures available to the computer. Prototype data-verification systems should be developed for all three data-processing environments as soon as possible. The WATSTORE system probably affords the greatest opportunity for long-range research and testing of new verification subroutines. (USGS)
W83-01855

AT-A-STATION HYDRAULIC GEOMETRY OF THE PLATTE RIVER IN SOUTH-CENTRAL NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
T. R. Eschner.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $8.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-436, 1982. 59 p, 21 Fig, 2 Tab, 36 Ref.

Descriptors: *Hydraulic geometry, *Channel morphology, *River flow, *Flow characteristics, Streamflow forecasting, Alluvial channels, Wildlife habitats, *Nebraska, Platte River.

At-a-station hydraulic-geometry of the Platte River in south-central Nebraska is complex. The range of exponents of simple power-function relations is large, both between different reaches of the river, and among different sections within a given reach. The at-a-station exponents plot in several fields of the b-f-m diagram, suggesting that morphologic and hydraulic changes with increasing discharge vary considerably. Systematic changes in the plotting positions of the exponents with time indicate that in general, the width exponent has decreased, although trends are not readily apparent in the other exponents. Plots of the hydraulic-geometry relations indicate that simple power functions are not the proper model in all instances. For these sections, breaks in the slopes of the hydraulic geometry relations serve to partition the data sets. Power functions fit separately to the partitioned data described the width-, depth-, and velocity-discharge relations more accurately than did a single power function. Plotting positions of the exponents from hydraulic geometry relations of partitioned data sets on b-f-m diagrams indicate that much of the apparent variations of plotting positions of single power functions results because the single power functions compromise both subsets of partitioned data. For several sections, the shape of the channel primarily accounts for the better fit of two-power functions to partitioned data than a single power function over the entire range of data. These non-log linear relations may have significance for channel maintenance. (USGS)
W83-01856

COST EFFECTIVE STREAM-GAGING STRATEGIES FOR MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO. 80225, Price: $6.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-507, July 1982. 43 p, 3 Fig, 6 Tab, 3 Ref.

Descriptors: *Cost analysis, *Data collections, *Networks, *Stream gages, Budgeting, Gaging stations, Hydrologic data, Hydrography, Backwater effect, Ice, *Maine.

This report documents the successful application of the traveling-hydrographer program developed by Moss and Gilroy to stream-gaging operations. This application was novel in the consideration of winter discharge records for the period of backwater effects due to ice. The current level of operation in Maine was identified as requiring a budget of $195,000 and having a total uncertainty of 374 cubic feet per second. Stream-gaging strategies were identified that could reduce the level of uncertainty in the system by as much as 45.8%, assuming the budgetary level remained constant. Alternately, practical stream-gaging strategies were also indentified that could reduce the total level of funding by as much as 19.2%, assuming the current level of uncertainty was deemed acceptable. Several alternatives of concurent budgeting and levels of uncertainty were identified. These relationships provide flexibility to the network manager. The results, documented in the report, were based on a sparse data base and should be applied in that context. (USGS)
W83-01857

7B. Data Acquisition

GEOPHYSICAL LOGGING SUPPLEMENTS TELEVISION INSPECTIONS,
Water Research Centre, Marlow (England).
K. Beesley.
Water Services, Vol 86, No 1038, p 379-380, August, 1982. 5 Fig, 1 Tab.

Descriptors: *Remote sensing, *Measuring instruments, *Maintenance, Wells, Television, Casings, Corrosion, *Geophysical logging, Acoustic televiewer, Caliper, Cement, Resistivity.

Television inspections of wells and boreholes alone are not always sufficient to reveal the exact nature of downhole problems. The selective use of geophysical logging techniques aids and clarifies the interpretation of television surveys. Logging techniques can 'see' where television cannot, such as behind casings and through dirty water. In addition, geophysical logging is often necessary when well construction records are poor or nonexistent. A tool called the acoustic televiewer enables sonic

pictures to be taken over the whole of the fluid filled section, and has the advantage of seeing through dirty water or mud. The tool is also fitted with orientation control. From the acoustic log the dip and orientation of the features can be determined, as the dimensions of the borehole are known from caliper logging. In the time needed to carry out the average television inspection of a borehole, several geophysical logs can be run. (Baker-FRC)
W83-01834

IMPROVED MICROAUTORADIOGRAPHIC METHOD TO DETERMINE INDIVIDUAL MICROORGANISMS ACTIVE IN SUBSTRATE UPTAKE IN NATURAL WATERS,
Naval Research Lab., Washington, DC.
For primary bibliographic entry see Field 5A.
W83-01993

7C. Evaluation, Processing and Publication

SPECIFIC CONDUCTANCE AND DISSOLVED CHLORIDE CONCENTRATIONS OF FRESHWATER AQUIFERS AND STREAMS IN PETROLEUM PRODUCING AREAS IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS Box 25425, Fed Ctr Denver, CO 80225. Paper copy $4.75, Microfiche $3.50. Geological Survey Open-File Report 82-353, 1982. 33 p, 6 Fig, 12 Tab, 12 Ref.

Descriptors: *Water quality, *Groundwater, *Surface water, *Specific conductivity, *Chlorides, Aquifers, Streams, Streamflow, Low flow, Water sampling, Sites, Wells, Oil fields, Brine disposal, Contamination, Data collections, *Mississippi.

Specific conductance and dissolved chloride reconnasissance sampling was conducted in six oil-producing areas of Mississippi during periods of low streamflow in 1980 and 1981. Water samples were collected at 224 ground-water and 190 suface-water sites. Samples from 55 surface-water and 17 ground-water sites contained dissolved chloride concentrations in excess of 100 milligrams per liter. All data collected are presented in tables without interpretation. (USGS)
W83-01851

QUALITY OF SURFACE WATERS IN WILTON, CONNECTICUT,
Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp.
Available from the OFSS, USGS Box 25425, Fed Ctr, Denver, CO. 80225, Paper copy $7.00, Microfiche $3.50. Geological Survey Open-File Report 82-260, 1982. 51 p, 2 Fig, 11 Tab, 11 Ref.

Descriptors: *Water quality, *Data collections, *Surface water, *Streams, Sampling, Sites, Bottom sediments, Ecosystems, Aquatic bacteria, Aquatic life, Phytoplankton, Invertebrates, *Connecticut, Wilton.

Water, bed material, and biological samples were collected and analyzed at 10 surface-water gaging sites on six streams in the town of Wilton, Connecticut over a 2-year period. The data indicate fair to excellent water quality. Fecal coliform bacteria, pH, alkalinity, iron, and manganese are the parameters that most often exceed recommended limits established by either the U. S. Environmental Protection Agency or the Connecticut Department of Environmental Protection. Data from sites on the Norwalk and East Branch Silvermine Rivers indicate little if any undesirable changes in water quality take place as they flow through the study area. (USGS)
W83-01852

ESTIMATING THE MAGNITUDE OF PEAK DISCHARGES FOR SELECTED FLOOD FREQUENCIES ON SMALL STREAMS IN SOUTH CAROLINA (1975),
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-01853

WATER RESOURCES DATA, WEST VIRGINIA, WATER YEAR 1981.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-148882, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-81-1, 1982. 505 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *West Virginia.

Water resources data for the 1981 water year for West Virginia consist of records of stage, discharge, and water quality of streams and springs; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 120 gaging stations, stage only records for 8 gaging stations, stage and contents for 8 lakes and reservoirs, contents for 1 reservoir, change in contents for 1 reservoir, water quality for 103 gaging stations, and water levels for 35 observation wells. Also included are 2 crest-stage partial-record stations, and 1 low-flow partial-record station. Additional water data were collected at various sites, not part of the systematic data-collections program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)
W83-01859

WATER RESOURCES DATA FOR PUERTO RICO, WATER YEARS 1979-80.
Geological Survey, San Juan, PR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-159483. Geological Survey Water-Data Report PR-79-80, 1982. 408 p, 19 Fig, 2 Tab, 25 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging Stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Puerto Rico.

Water-resources data for surface-water, quality-of-water, and ground-water records for 1979-80 water years for Puerto Rico consist of records of discharge, water quality of streams, and water levels of wells. This report contains discharge and water-quality records for 36 gaging stations, 109 water-quality stations, and water levels for 50 observation wells. Also included are data for 17 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and the Commonwealth of Puerto Rico. (USGS)
W83-01860

WATER RESOURCES DATA FOR OKLAHOMA, WATER YEAR 1980.
Geological Survey, Oklahoma City, OK. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190356, Price codes: A12 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OK-80-1, 1982. 613 p, 8 Fig,

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oklahoma.

Water resources data for the 1980 water year for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes or reservoirs. This report contains discharge records for 138 gaging stations, stage and content for 25 lakes or reservoirs, water quality for 77 gaging stations and 3 lakes, and water levels for 43 wells. Also included are 44 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (USGS)
W83-01862

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME I, SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES: A SUMMARY BY GEOGRAPHIC AREA,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982. 164 p, 82 Fig, 12 Tab. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Great Lakes, Fish eggs, Fish nursery, Environmental effects, Spatial distribution, Tributaries, Littoral zone, Channels.

The information in this atlas of spawning and nursery areas may be used to support permit and project reviews, impact statement reviews, planning of baseline research, coordination with other agencies, and identification of data gaps. This volume was prepared to permit quick determination of whether a particular geographic area of interest in the Great Lakes or their connecting waters contains fish spawning or nursery areas that are identified in volumes II-XII of the atlas. Information is presented for each of the five Great Lakes by lake, by statistical fishing district within the lake and by geographic area within the statistical fishing district. Each geographic area includes about 20 miles of shoreline together with the adjacent littoral and offshore waters. Tables list the species or taxonomic groups that have spawning or nursery areas in each geographic area; indicate whether the areas are located in tributary, littoral, offshore, or navigation channel waters within the geographic area; list the spawning or nursery areas as confirmed, probable, or potential; and identify species whose continued existence was considered to be in jeopardy. Twenty-two taxonomic groups and 117 fish species are included in this study. (Moore-SRC)
W83-01871

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME II, LAKE SUPERIOR,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982. 122 p, 11 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Distribution, *Aquatic habitats, *Lake Superior, Fish nursery, Spatial distribution, Great Lakes, Fish eggs, Larvae, Cisco, Trout, Salmon, Sculpin.

More than 60 species of fish have been recorded as residents of Lake Superior. This volume describes the reproductive habitat used by the 49 species for which information was available. Most of the 39 native species spawned in tributaries or in shallow, protected waters of the lake. Only six species, including the lake trout, lake herring, three species of ciscoes, and the fourhorn sculpin, utilized the deep offshore waters for spawning. Two of these deepwater spawners, the blackfin cisco and short-

nose cisco, are now believed to be extinct. Only the lake trout spawned in the tributaries, the shallow nearshore waters, and the deeper offshore waters. Five of the exotic species are salmonids which are believed to spawn exclusively in tributaries. Four spawn in tributaries and also in protected nearshore waters in some areas. Information on nursery areas is fragmentary, but it suggests that tributaries and nearshore waters are important as nursery areas, at least for the earliest life history stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of salmonids that spawn in tributaries may remain in or near the spawning areas in those tributaries for as many as three years before entering the lake and dispersing. (Moore-SRC)
W83-01872

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME III, ST. MARY'S RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982. 29 p, 7 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Distribution, *Aquatic habitats, *St. Marys River, Great Lakes, Fish nursery, Tributaries, Rapids, Bays, Fish eggs, Sturgeon, Trout, Salmon, Carp, Alewife, Pike, Smelt.

Historically, the St. Marys rapids were a major spawning area for lake sturgeon, lake whitefish, brook trout, and walleyes. The Canadian waters in the rapids area has a wider variety of substrate and provide more ideal spawning and nursery habitat than do the U. S. waters. Whitefish Channel contains relatively calm pools which are important reproductive habitat; the wetlands and extensive areas of shoals in the river also provide favorable reproductive habitat. Information was available on the reproductive habitat used by 35 of the 60 species of fish which have been recorded as residents or migrants. Most of the 27 native species spawned in tributaries to the river, in the shallow bays and shoreline areas, or in the St. Marys rapids. Sturgeon is the only species believed to spawn in deeper areas in the river channel. Four of the 8 exotic species are salmonids that spawn in the rapids or in tributaries. Smelt also spawn in tributaries; alewives and carp spawn in the protected bays. Information on nursery areas suggests that tributaries and nearshore waters, especially the bays, are important as nursery areas, at least for the earliest life history stages. Dispersal from spawning areas in rapid for some species which have small, pelagic larvae, whereas the juveniles of most salmonids that spawn in the rapids area or in tributaries may remain in or near those spawning areas for at least one year before dispersing. (Moore-SRC)
W83-01873

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME IV, LAKE MICHIGAN,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982. 209 p, 17 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Lake Michigan, *Aquatic habitats, *Distribution, *Fish, Great Lakes, Fish nursery, Fish eggs, Dam effects, Tributaries, Water pollution effects, Trout, Cisco, Sculpin, Salmon, Larvae.

Historically, large amounts of fish spawning habitat in Lake Michigan was destroyed or degraded by sawmill wastes, which covered spawning grounds in tributaries and near stream mouths, and by the construction of dams which blocked spawning migrations into tributaries. By the late 1800s, spawning grounds in Grand Traverse Bay and the Muskegon River had been degraded by sawdust. By the early 1900s, tthe Fox River was suitable for spawning because of the large number of dams and bottom deposits. Reproductive habitat is described for 64 species. Most of the 52 native species spawned in tributaries, reef areas, or in shallow, protected waters of the lake. Only the lake trout, seven species of ciscoes, and the fourhorn sculpin, utilized the deep offshore waters of spawning, and six of the ciscoes are believed to be extinct in Lake Michigan. Only the lake trout spawned in the shallow nearshore waters and also in deeper offshore waters. Six of the 12 exotic species are salmonids which spawn in tributaries; the other six exotic species spawn both in tributaries and in protected nearshore waters. Information suggests that tributaries and nearshore areas are important as nursery areas, at least for the earliest life stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of some salmonids may remain in or near spawning areas in tributaries for as long as three years before entering the lake and dispersing. (Moore-SRC)
W83-01874

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME 5, LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982. 121 p, 14 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Lake Huron, *Aquatic habitats, *Distribution, *Fish, Great Lakes, Larvae, Fish nursery, Fish eggs, Trout, Sculpin, Cisco, Salmon, Splake, Tributaries.

Almost 90 species of fish have been recorded as residents in Lake Huron. The reproductive habitat used by the 61 species for which information was available is described. Most of the 47 native species spawned in tributaries or in shallow, protected waters of the lake. Only the lake trout, five species of ciscoes, and the fourhorn sculpin, utilized the deep offshore water for spawning. Four of these deepwater spawners, the blackfin cisco, shortjaw cisco, deepwater cisco, and kiyi are now believed to be extinct in Lake Huron. Only the lake trout spawned in the swallow nearshore waters and also in the deeper offshore waters. Eight of the exotic species are salmonids which spawn in tributaries; the other six exotic species spawn in tributaries and also in protected nearshore waters in some areas. The splake, an artificial hybrid, apparently spawns in the nearshore waters. Tributaries and nearshore waters are important as nursery areas, at least for the earliest life stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the junveniles of some salmonids may remain in or near spawning areas in the tributaries for as long as three years before entering the lake and dispersing. (Moore-SRC)
W83-01875

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VI, ST. CLAIR RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 25 p, 2 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *St. Clair River, *Fish migration, Great Lakes, Fish nursery, Fish eggs, Tributaries, Trout, Shad, Carp, Alewife, Sturgeon, Muskellunge, Larvae.

The St. Clair River, together with Lake St. Clair and the Detroit River, forms the connecting waterway between Lake Huron and Lake Erie. This waterway and its tributaries are important spawning and nursery areas for many species that support major fisheries in the waterway and in Lake Huron and Lake Erie. Almost 90 species of fish have been recorded as residents, or migrants, in the St. Clair River and its delta; of these, information was available on reproductive habitat for 28 species. Most of the 22 native species probably spawned in tributaries to the river or in shallow embayments and shoreline areas. Lake sturgeon and muskellunge are believed to be the only native species that spawned in the deeper areas of the river channel. Of the exotic species, rainbow trout spawn in the tributaries or along shore. Smelt also spawn in tributaries; alewives, carp and gizzard shad probably spawn in the tributaries and also in protected areas near shore. The river is an important migratory route for larvae which move through it in large numbers. Although the residence time of most larvae must be short because of the swift currents that prevail, the river must be considered an important nursery area. (Moore-SRC)
W83-01876

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VII, LAKE ST. CLAIR,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 42 p, 13 Ref. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distributiom, *Lake St. Clair, Great Lakes, Fish nursery, Fish eggs, Muskellune, Shad, Carp, Wetlands, Tributaries, Fisheries.

Lake St. Clair forms part of the connecting waterway between Lake Huron and Lake Erie. The bays and wetlands of Lake St. Clair, especially in the St. Clair Flats area at the mouth of the St. Clair River, are important spawning and nursery areas for many species that support major fisheries in the waterway and in Lake Huron and Lake Erie. More than 70 species of fish have been recorded as residents, or migrants, in Lake St. Clair; reproductive habitat is provided for 34 species. Most of the 28 native species spawned in the shallow, productive St. Clair flats area, along shore, or in tributaries to the lake. Muskellunge may be the only native species that spawns in deeper areas of the lake. Of the six exotic species, smelt probably spawn in tributaries; alewives, gizzard shad, carp, and goldfish spawn in the bays and marshes of the Flats and in other shoreline areas. (Moore-SRC)
W83-01877

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME VIII, DETROIT RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 40 p, 9 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Detroit River, *Fish migration, Great Lakes, Fish nursery, Fish eggs, Larvae, Smelt, Alewife, Shad, Carp, Tributaries.

The Detroit River, together with the St. Clair River and Lake Erie. This connecting waterway and its tributaries are important spawning and nursery areas for many species that support major fisheries in the waterway and in Lake Huron and Lake Erie. Twenty-seven of the 32 species for which reproductive habitat information is available are native to the Detroit river. Most of the islands in the lower portion of the river. Many of these areas in the lower river have been degraded. Of the exotic species, smelt spawn along island shorelines; alewives, gizzard shad, carp, and goldfish probably spawn in protected aeas near shore. The river is an important migration route for larvae which move through it in large numbers during the summer. Although the residence time of most larvae may be short because of the swift currents that prevail, the river must be considered an important nursery area. (Moore-SRC)
W83-01878

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME IX, LAKE ERIE,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 202 p, 25 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Lake Erie, Great Lakes, Fish nursery, Fish eggs, Tributaries, Shiner, Salmon, Larvae.

Of the 91 species for which Lake Erie reproductve habitat information is available, 81 were native to the lake. Most of the native species spawned in tributatries or in shallow, protected waters of the lake. Only the emerald shiner utilizes the deep offshore waters, along with the nearshore waters, for spawning. Four of the ten exotic species are salmonids which spawn in tributaries; the other six spawn in tributaries and also in protected nearshore waters in some areas. Information on nursery areas used by the 91 species treated in this volume is fragmentary, but as would be expected, it suggests that tributaries and nearshore waters are important as nursery areas, at least for the earliest life stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of some salmonids that spawn in tributaries may remain in or near spawning areas in those for as long as three years before entering the lake and dispersing. (Moore-SRC)
W83-01879

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME X, NIAGARA RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 22 p, 5 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Niagara River, *Fish migration, Great Lakes, Fish nursery, Fish eggs, Trout, Smelt, Carp, Aquatic plants, Tributaries.

The Niagara River forms the connecting waterway between Lake Erie and Lake Ontario. Niagara Falls, approximately 15 mi downstream from Lake Erie, divides the river into upper and lower sections. Historically, narrow zones along each shore of the lower river supported rooted aquatic vegetation. In the upper river, extensive beds of aquatic macrophytes were present in the shallow bays and shoal areas around Grand Island. These weed beds were important areas of fish reproduction. Tributaries to the upper river also supported large spawning migrations in the spring and were important breeding areas. The abundance of young fish and low numbers of adults in the upper river indicated that the young fish moved out of the upper river and into Lake Erie. Almost 80 species of fish have been recorded as residents or migrants, and information on reproductive habitat was available for 24 species. Most of the 20 native species probably spawned in tributaries to the river or in the shallow embayments and shoreline areas, and around the islands in the upper river. Of the four exotic species, rainbow trout probably spawn in the tributaries and also in protected areas near shore. (Moore-SRC)
W83-01880

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XI, LAKE ONTARIO,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 117 p, 19 Fig. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Lake Ontario, Great Lakes, Fish nursery, Fish eggs, Larvae, Cisco, Trout, Herring, Sculpin, Tributaries.

More than 90 species of fish have been recorded as residents in Lake Ontario; reproductive habitat is described for the 67 species for which information is available. Most of the 55 native species spawned in tributaries or in shallow, protected waters of the lake. Only the lake trout, lake herring, four species of ciscoes, and the slimy sculpin utilized the deep offshore waters for spawning. Four of these deepwater spawners, the blackfin cisco, shortjaw cisco, deepwater cisco, and kiyi are now believed to be extinct in Lake Ontario. Lake trout and lake herring spawned in the shallow nearshore waters and also the deeper offshore waters. Six of the twelve exotic species are salmonids which spawn in tributaries. The other six exotic species spawn in tributaries and also in protected nearshore waters in some areas. Information on nursery areas used by these 67 species is fragmentary, but is suggests that tributaries and nearshore waters are important as nursery areas, at least for the earliest life stages. Dispersal from spawning areas is rapid for some species which have small, pelagic larvae, whereas the juveniles of some salmonids that spawn in tributaries may remain in or near spawning areas in those tributaries for as long as three years before dispersing. (Moore-SRC)
W83-01881

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XII, ST. LAWRENCE RIVER,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 34 p, 3 Fig.

Descriptors: *Spawning, *Fish, Aquatic habitats, *Distribution, *St. Lawrence River, Great Lakes, Fish nursery, Fish eggs, Dam effects, Fish migration, Tributaries, Salmon, Smelt, Alewife, Carp.

The St. Lawrence River forms the connecting waterway between Lake Ontario and the Atlantic Ocean. Only the international section of the river is considered in this atlas. The important breeding habitats in the international section of the St. Lawrence River are in inshore areas, including the extensive wetlands and marshes, and the tributary streams. Historically, the tributaries (which warm earlier than the main stem of the river) were very important spawning grounds for many St. Lawrence fish species, which often run long distances upstream. Young fish remained in the creek mouths for some period of time before moving into the river. The habitats and migration patterns have been drastically altered by the extensive dam construction which has occurred on the river. In addition to the Moses-Saunders Dam on the main river at Cornwall, every major tributary is dammed within 20 mi of its mouth. The river mouths are still important spawning areas. Information on reproductive habitat is available for 45 of the more than 100 species of fish that have been recorded as residents or migrants. Most of the 40 native species probably spawned in tributaries to the river or in shallow embayments and shoreline areas, and around the islands in the upper river. Of the five exotic species, coho salmon probably spawn in the tributaries; alewives and carp probably spawn in the tributaries and also in protected areas near shore. (Moore-SRC)
W83-01882

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XIII, REPRODUCTIVE CHARACTERISTICS OF GREAT LAKES FISHES,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 153 p. NCE-IS-78-30.

Descriptors: *Spawning, *Fish reproduction, *Aquatic haitats, *Distribution, *Great Lakes, Fish nursery, Fish eggs, Fish migration.

This volume presents concise descriptions of the reproductive characteristics and related spawning and nursery habitat requirements of each of the fish species included in Volumes I-XII of the atlas. These descriptions were compiled mainly from the information for Great Lakes populations presented in the other volumes. When additional information was needed to complete the descriptions, information was included for non-Great Lakes populations in the Province of Ontario and the eight states bordering the Great Lakes; in some instances information for populations outside the Great Lakes region was included. The following information is included for each of the 116 species: prespawning and postspawning migration of adults; spawning season, site, substrate and water depth; incubation and hatching duration and site; distribution and movement of young. (Moore-SRC)
W83-01883

SIMPLIFIED TESTING OF HYDROLOGIC REGRESSION REGIONS,
Geological Survey, Reston, VA.
G. D. Tasker.
Journal of the Hydraulics Divsion, Proceedings of the the American Society of Civil Engineers, Vol 108, No HY10, p 1218-1222, October, 1982. 1 Tab, 5 Ref.

Descriptors: *Regression analysis, *Cluster analysis, *Hydrologic models, *Rainfall-runoff relationships, Error analysis, *Minnesota, Gaging stations, Statistical analysis, Wilcoxon Signed Ranks Test, Data processing, Mathematics.

Hydrologists using regional regression models to transfer information from gaged sites to improve estimates at gaged sites or create data for ungaged sites often subjectively divide the residuals into similar clusters on a map. The Wilcoxon Signed Ranks Test is proposed for testing the statistical significance of such clusters of regression residuals. It assumes each residual in a region to be a continuous random variable from a symmetric distribution with mean of zero. Residuals are mutually independent. The procedure is applied to data from 84 small drainage area stations in Minnesota to estimate parameters of log linear regression of 2-year peak discharges. (Cassar-FRC)
W83-01922

8. ENGINEERING WORKS

8A. Structures

MUDFLOW DETENTION DAM AT MYNZHILKI,
Yu. N. Zinevich.
Hydrotechnical Construction, Vol 15, No 12, p 762-767, December 1981. 2 Fig, 6 Ref, Translated from Gidrotekhnicheskoe Stroitel'stvo, No 12, p 33-35, December 1981.

Descriptors: *Dams, *Mudflows, *Glaciers, Mynzhilki Dam, *USSR, Little Almatinka River, River basins, Construction.

Little Almatinka is one of the most mudflow-active rivers in the Soviet Union, with catastrophic mudflows causing considerable damage to the city nearby. Headwaters for the river are located in the glacial zone at 3500 m. Here are located 12 glaciers with a total of 11.4 sq km and several glacial lakes which fill to overflowing in the summer melt period. In 1978 the design of a new Mynzhilki mudflow detention dam was completed. The side of the dam closes the trough valley of the same name and is located at a distance of 1.5 km from the river headwaters at a height of 3010 m. The dam is intended to prevent the formation of mudflows of the glacial type. The Medeo detention dam is complemented by the second dam, in that the former one is designed to control the main part of the basin of the Little Almatinka with its numerous mudflow-danger tributaries and the Mynzhilki dam controls only the upper reaches of the main channel of the Little Almatinka. The structures of the Mynzhilki mudflow detention dam include an earth dam of boulders and gravel, an automatic

outlet, and an emergency catastrophic spillway. (Baker-FRC)
W83-01767

CONVERTING AN ESTUARY TO LAKE GREVELINGEN: ENVIRONMENTAL REVIEW OF A COASTAL ENGINEERING PROJECT,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
For primary bibliographic entry see Field 6G.
W83-01784

PHASE II INSPECTION OF LAKE MANATEE DAM,
Bromwell Engineering, Inc., Lakeland, FL.
W. D. Carrier, III, B. Keshian, Jr., and L. G. Bromwell.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT10, p 1273-1287, October, 1982. 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Dam stability, *Spillways, *Seepage control, Inspection, Earth dams, Lake Manatee Dam, *Florida, Reservoir operation, Drains, Design criteria, Embankments, Slope stability, Stability analysis.

Lake Manatee Dam, constructed during 1965-67, supplies water for 250,000 people in the Bradenton-Sarasota area of Florida. It is composed of 3 earthen zones (inner clay core and 2 outer layers of sand and silty sand). The dam is 5000 ft long, with a crest elevation of 50-52 ft and a 100 ft long spillway. During the Phase I inspection in 1978 two major problems were revealed: a spillway capacity inadequate for a major storm and inadequate seepage controls. The dam was classified as large with a high hazard potential. Construction of an emergency spillway was recommended. Phase II inspection, May-October 1979, was extensive because much design and construction data were missing. This investigation indicated that the embankment has a satisfactory factor of safety (minimum, 2) against slope failure, and the concrete spillway has a satisfactory factor of safety (4) against overturning. The toe drain, not constructed in accordance with drawings and specifications, was partially clogged by the fine fraction in the inner gravel filter. It was recommended that a new toe drain be installed, using filter cloth and clean durable gravel. The recommended design also specified that the toe drain be extended further up the abutments to intercept seepage. A step-by-step procedure was developed to operate the spillway in case of a 100 year storm (16,000 cfs). To handle the probable maximum flood (67,000 cfs) construction of an emergency spillway was suggested. A detailed instrument reading schedule was given for monitoring drain performance, settlement, and slope stability.
W83-01917

OPTIMAL DESIGN OF STILLING BASINS FOR OVERFLOW SPILLWAYS,
Nevada Univ., Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1163-1178, October, 1982. 9 Fig, 5 Tab, 7 Ref.

Descriptors: *Stilling basins, *Dam design, *Hydraulic jump, Optimization, Model studies, Spillways, Overflow, Design criteria, Hydraulic structures, *Texas, Energy dissipation, Baffles.

A model is given for determination of the optimum floor elevation and basin width and corresponding dimensions of appurtenances for stilling basins for overflow dam spillways. The procedure is divided into two phases to determine: (1) the appropriate combination of spilling basin width and elevation to satisfy hydraulic performance requirements, and (2) the minimum-cost design which satisfies required performance. The procedure is applied to stilling basins of three existing dams in Texas, Rockwall-Forney, Conroe, and Twinbutts. The Conroe and Twinbutts stilling basins are conservatively designed to prevent downstream scoring. Rockwall's hydraulic jump would sweep out of the basin at discharges exceeding 230,000 cfs. Conroe's actual design is close to the optimum as determined by the model. In practice, an optimization model is useful in preliminary planning. Scale model studies are generally necessary to develop a final design. (Cassar-FRC)
W83-01918

OPTIMUM PROFILES OF GRAVITY DAMS,
C. S. Joshi.
International Water Power and Dam Construction, Vol 34, No 9, p 35-36, September, 1982. 4 Fig.

Descriptors: *Gravity dams, *Design criteria, *Slopes, Construction, Engineering, Tension, *Optimization.

Arguments in favor of adopting two downstream slopes for a gravity dam profile are considered. While substantial savings result for dams in the height range of 50-70 m, even for dams of heights about 30 m there are savings to be realized. Two design considerations which should be met are: the upstream heel should not develop any tension for any of the combinations of loads when the reservoir is either at full supply level or at maximum flood water level; and the downstream toe should not develop any tension for any of the load combinations during construction, such as when the reservoir is empty or when the water level is at its minimum. From about 10 profiles designed using the method described in the article of dams ranging between 30 and 70 m high, it is noted that the second slope needs to be started at about 14 m to 24 m below the water surface, a lower value for lower design head and higher value for higher design head; the rate of change in the value of the second slope needed goes on decreasing as the design water head increases and the increase becomes very small for dams exceeding 90 m in height to satisfy the condition of no tension on the upstream heel; for the same design head and with different points of starting of the second downstream slope, the profile with the least cross-sectional area develops the least downstream normal stress. (Baker-FRC)
W83-02082

8B. Hydraulics

ASYMMETRIC FLOW IN SYMMETRIC EXPANSIONS,
S. D. Graber.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1082-1101, October 1982, 11 Fig, 18 Ref.

Descriptors: *Channel flow, *Flow patterns, *Deflection, Asymmetric flow, Flow expansion, Hydraulic profiles, Vortices, Vanes, Scour, Channel scour, Stability analysis.

Asymmetrical flow patterns, usually detrimental in channels and pumping plants, may occur in symmetrical abrupt expansions, where the main flow deflects and attaches to one wall of the expansion. The adverse effects include lengthening the distance to full-width flow in expansions, scour of downstream channel banks, inefficient operation of screens in screen channels, and increasing the potential for vortexing in pump intakes. The asymmetric behavior is attributed to a static instability of the system occurring under certain conditions of expansion geometry. Forces acting on the system when it undergoes a small deflection from the symmetric position are analyzed. The deflection causes a destabilizing pressure differential opposed by a stabilizing momentum reaction that tends to restore the system to its position of symmetry. The stability of the system depends on the variation of these competing forces during small deflections. Stability results if the change in the stabilizing momentum reaction exceeds the change in the destabilizing pressure force. If not, an asymmetric flow pattern occurs. A mathematical stability criterion is developed and applied to subcritical, horizontal, rectangular expansions. Results agree well with experimental observations in published literature. Measures to prevent and correct undesirable asymmetric flow in sudden expansions include communication between the eddy regions with a pipe or addition of a vane parallel to, and in the center of, the flow, extending from the plane of separation to the plane of reattachment. (Cassar-FRC)
W83-01887

MODEL STUDY OF LOW DROP GRADE CONTROL STRUCTURES,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
W. C. Little, and J. B. Murphey.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1132-1146, October 1982, 9 Fig, 3 Tab, 7 Ref.

Descriptors: *Erosion control, *Overfalls, *Stilling basins, Design criteria, Hydraulics, Bank erosion, Channel erosion, Hydraulic jump, Alluvial channels, Scour, Channel scour, Baffles, Energy loss, Low drop structures, *Mississippi, *Arkansas.

Low drop grade control structures were objected to model studies for the purpose of designing structures for the purpose of designing structures for installation in creeks in Mississippi and Arkansas. These structures control the severe channel degradation seen in alluvial valley streams in which headcuts or overfalls of 0.3-1.5 m in height progress upstream, causing bed scour, bank slumps and slides, and channel widening. Low drop is defined as a hydraulic drop with a relative drop height equal to or less than 1; a high drop has a similar value of greater than 1. The relative drop height is defined as the difference in elevation between upstream and downstream channel beds divided by the critical depth. Using a model basin, tentative design criteria were developed for stilling basins for low drops with energy dissipation devices. A method is also given to determine the size and placement of a baffle pier or plate to obtain optimum flow conditions downstream. (Cassar-FRC)
W83-01888

TIME SCALE FOR SCOUR DOWNSTREAM OF HYDRAULIC JUMP,
J. Farhoudi, and K. V. H. Smith.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1147-1162, October 1982.

Descriptors: *Scour, *Hydraulic jump, Energy dissipation, Hydraulic properties, Erosion, *Timing, Estuaries.

The time scale of scour development downstream from a hydraulic structure is very important in the case of rivers with short duration peak flows. This paper discusses Breusers' work on scour downstream of estuary closure structures and extends it to the case of local scour downstream of a hydraulic jump. Experiments were conducted in small, medium, and large flumes with bed materials of particle sizes 0.25 and 0.52 mm (bakelite) and 0.15-0.85 mm (sand). The relationship between maximum scour depth and time of scour depth and time of scour development was of the same form for the hydraulic jump and for the Breusers estuary closure structure. However, the value of the exponent, alpha, was different. A prototype problem investigated scour resulting from a plunge-type energy dissipator which had an overflow weir expected to overflow infrequently and for a short period. The 1/12 scale model also had 1/12 scale in time to scour development, that is, 1 min of model time to scour represented 12 min of prototype time to scour. This relationship can be used to calculate time to scour from a model for prototypes or models of different sizes. (Cassar-FRC)
W83-01889

EQUIVALENT ROUGHNESS OF ALLUVIAL BED,
Waterloopkundig Lab., Delft (Netherlands).
L. C. van Rijn.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108,

No HY10, p 1215-1218, October, 1982. 2 Fig, 13 Ref.

Descriptors: *Hydraulic roughness, *Flow resistance, *Bed sediment, Alluvial channels, Sediment transport, River beds, Channel flow, Streamflow.

A relationship between the dimensions of the bed forms and their effective roughness is developed for flow conditions with a movable bed or movable bed forms. The effective roughness of a plane movable bed varied from about 1 to 10 D90 of the bed material and was not dependent on transport stage. The effective roughness of the bed forms depended on the height/steepness ratio of the movable bed forms. (Cassar-FRC)
W83-01923

RECOVERY IN LARGE DIAMETER WELLS,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
P. Basak.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1194-1207, October, 1982. 7 Fig, 2 Tab, 5 Ref.

Descriptors: *Drawdown, *Open wells, *Groundwater movement, Well yield, Shallow wells, Fully penetrating wells, India, Dug wells, Confined aquifers.

A closed-form approximate analytical solution for recovery in fully-penetrating large diameter wells tapping a confined aquifer was developed. Transient recovery responded logarithmically with time, inflow rate decreased exponentially with time, and cumulative recovery increased asymptotically with time. Predictions agreed very well with field data from 6 wells, 4-7 m deep and 1-3 m in radius, dug in a variety of soils: fractured rocks, laterite, and alluvial sand. Solutions are also valid for unconfined flow conditions under small drawdown at all times and under larger initial drawdown at later times. (Cassar-FRC)
W83-01924

TABULAR REPRESENTATION OF CROSS-SECTIONAL ELEMENTS,
Linsley, Kraeger Associates Ltd., Mountain View, CA.
D. D. Franz.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1070-1081, October, 1982. 1 Fig, 4 Tab, 7 Ref.

Descriptors: *Error analysis, *Cross-sections, *Tables, Streams, Channel morphology, Hydraulics.

A table of values and rules for interpolation are presented for defining consistent values for the cross-sectional elements of top width, area, first moment of area, and second moment of area for an irregular stream cross section. The variation of the top width is taken to be piecewise linear and continuous. The top width is then integrated exactly to obtain the values for the other elements. Integration is also used in interpolation. Values obtained with this procedure are consistent with the mathematical definition of the elements. In an example, errors from operational assumptions and from the basic top width data are estimated separately. The operational error is much smaller than the inherent error at larger depths and of the same order at smaller depths. (Cassar-FRC)
W83-01926

SHORE LINE EFFECTS ON MIXING OF TEE DIFFUSER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams, W. C. Skamarock, and R. U. Nothaft.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY10, p 1232-1238, October, 1982. 2 Fig, 7 Ref.

Descriptors: *Mixing, *Thermal pollution, Heated water, Shallow water, Shores, Fate of pollutants, Dilution, *Diffusers, *Tee diffuser.

A semi-empirical theory for a shallow water tee diffuser in quiescent water of large horizontal extent is modified to include the effects of shore line proximity. The theory was tested on a laboratory model. To obtain dilution equal to 90% or better of that predicted for an unconfined water body, the distance between the diffuser and the shore must be at least 80% of the diffuser length. For 70% of the dilution, the separation distance may be as little as 35% of the diffuser length. The results assume a constant receiving water depth. For a sloping bottom, the distance between diffuser and shore is divided by 2 for use in the equation. (Cassar-FRC)
W83-01928

NUMERICALLY COMPUTED MULTIPLE STEADY STATES OF VERTICAL BUOYANCY-INDUCED FLOWS IN COLD PURE WATER,
State Univ. of New York at Buffalo, Amherst. Dept. of Mathematics.
I. El-Henawy, B. Hassard, N. Kazarinoff, B. Gebhart, and J. Mollendorf.
Journal of Fluid Mechanics, Vol 122, p 235-250, 1982. 10 Fig, 2 Tab, 22 Ref.

Descriptors: *Buoyancy, *Flow, Hydrodynamics, Fluid mechanics, Velocity, Temperature effects, Laminar flow, Surface flow.

The laminar, boundary-layer, natural convection flow adjacent to a vertical, heated or cooled, flat surface submerged in quiescent cold water was studied. The results demonstrate for the first time the existence of multiple steady-state solutions in a natural convection flow. The calculated velocity profiles over a range of the parameters are compared with recent corresponding velocity measurements. The newly found additional steady-state solutions are of considerable practical interest because the heat-transfer rates for a pair of solutions (with determining physical parameters and boundary conditions otherwise identical) are sometimes vastly different. An important consequence of this study is the possible relationship of multiple steady-state solutions to the recently observed unsteadiness in some such flows. (Baker-FRC)
W83-01989

ON THE STRUCTURE OF TURBULENT CHANNEL FLOW,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Mechanics.
A. V. Johansson, and P. H. Alfredson.
Journal of Fluid Mechanics, Vol 122, p 295-314, 1982. 16 Fig, 1 Tab, 24 Ref.

Descriptors: *Channels, *Surface flow, *Turbulence, Flow, Hydrodynamics, Reynolds numbers, Stream flow, VITA technique.

Hot-film measurements of the streamwise velocity component were carried out in a fully developed turbulent water channel flow for three different Reynolds numbers (13800, 34600, and 48900). The results for the first four statistical moments complement and extend the results from previous studies of turbulent channel flow. The VITA variance technique was used to detect deterministic events in the streamwise velocity. It was demonstrated that the VITA technique has a band-pass-filter character. The number of events detected was found to decrease exponentially with the threshold level, and the events occupy a wide range of timescales. This makes it impossible to define one unique frequency of occurrence or one unique duration of the events. However, by using this technique information was obtained on the amplitude and timescale distributions of the events. The characteristic features of the conditional averages were related to the skewness and flatness factors. (Baker-FRC)
W83-01990

BOUYANCY-DRIVEN CIRCULATION IN FREE-SURFACE CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. C. Jain.
Journal of Fluid Mechanics, Vol 122, p 1-12, 1982. 7 Fig, 9 Ref.

Descriptors: *Channels, *Water circulation, Flux, Buoyancy, Temperature effects, Velocity, Flow, Mathematical equations, Heat loss, Surface flow, Hydrodynamics.

The convective circulation driven by a surface buoyancy flux in a dead-end open channel is analyzed. Making the assumption of similarity profiles for velocity and temperature, the governing partial differentials are reduced to two nonlinear ordinary differential equations by integrating over the flow depth. A closed-form solution of the differential equations is presented. The solution is a function of the Grashof number G and the modified Prandtl-Grashof number PmG1/2. The velocity and temperature along the channel vary linearly as the distance and as the square of the distance respectively. Analytical expressions for the rate of total heat loss from the channel and the rate of flow in the channel are derived. The analytical results compare well with the available experimental data. (Baker-FRC)
W83-01991

SELF-SIMILAR PARTICLE-SIZE DISTRIBUTIONS DURING COAGULATION: THEORY AND EXPERIMENTAL VERIFICATION,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
J. R. Hunt.
Journal of Fluid Mechanics, Vol 122, p 169-185, 1982. 7 Fig, 34 Ref.

Descriptors: *Coagulation, *Particulate matter, Estuaries, Coastal waters, Kinetics, Brownian motion, Fluid mechanics, Hydrodynamics, Particle size, Hydraulic engineering, Suspended solids, Sedimentation.

A quantitative theory for particle coagulation in continuous particle size distributions is presented and experimentally verified. The analysis, flowing Friedlander, assumes a local equilibrium in the size distribution maintained by a particle flux through the size distribution. Only particle collisions caused by Brownian motion, fluid shear and differences in settling velocities are considered. For intervals of particle size where only one coagulation mechanism is dominant, dimensional analysis predicts self-similar size distributions that contain only one dimensionless constant for each mechanism. Experiments were designed to test these predictions with clay particles in artificial seawater sheared in the gap between concentric rotating cylinders. Particle-size distributions measured over time were self-similar in shape and agreed with the Brownian- and shear-coagulation prediction in terms of shape and dependence on fluid shear rate and particle volume flux through the size distribution. (Baker-FRC)
W83-01992

ICE PRESSURE ON A VERTICAL SUPPORT (DISCUSSION OF CONSTRUCTION SPECIFICATIONS),
N. G. Khrapatyi.
Hydrotechnical Construction, Vol 15, No 12, p 775-779, December, 1981. 3 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 12, p 40-42, December, 1981.

Descriptors: *Ice pressure, *Dams, *Design criteria, *Construction specifications, Ice, Ice Jams, Ice cover, Ice thickness, Engineering.

The design pressure at the contact of ice with a vertical structure is determined by the ratio of the value of the ice load to the area of contact and is assumed equal to the uniaxial compressive strength of an ice sample, corrected by coefficients for the local crushing of the ice shape of the support and the density of the contact. Experimental results of measuring the ice load (the contact pressure) show that there are substantial differences in the case of this interaction of rectangular or round supports of

hydraulic structures with the ice cover. This is especially noticeable in the case of indentation and penetration of ice by the supports. An examination is reported of the process of loading the edge of the ice cover at a separately standing vertical support when D/H is less than one (D being the diameter of the support and H the thickness of the ice), when the contact pressure exceeds the elastic limit of ice. The relationship of the effect of the ratio D/H to the contact strength of the ice cover was determined. (Baker-FRC)
W83-02086

8C. Hydraulic Machinery

ADDING A FIFTH UNIT TO IDAHO'S BROWNLEE DAM,
International Engineering Co., Inc., San Francisco, CA. Water Resources Div.
For primary bibliographic entry see Field 8E.
W83-01846

SAVINGS FLOW FROM PUMPS USED AS TURBINES.
Journal of the American Water Works Association, Vol 74, No 10, p 27, 30, 32, October, 1982. 3 Fig.

Descriptors: *Electric power production, *Hydroelectric power, *Turbines, *Hydraulic turbines, *Pump turbines, *Performance evaluation, Electric power costs, Electric powerplants, Pumps, Hydraulic machinery, Hydraulic equipment, *New York City.

The Bureau of Water Supply of the city of New York has saved thousands of dollars in electricity costs by running two large pumps as turbines and capturing hydropower to supply water to the Delaware Aqueduct. The Delaware Aqueduct carries water from more distant higher altitude sources than the older Croton Reservoir network. The greater pressure can gravity-feed higher elevations of New York City. After thirty years, the pump still functions well, with almost no maintenance. The cost of running the pumps compared with electrical pumps is almost nil. Various government and private firms are studying use of water to drive hydraulic turbines in view of rising electrical costs. Many pumps have been tested as turbines. As such, the head and flow of their best efficiency point (BEP) are higher than the pump input power at its BEP. When pumps operate as turbines, the maximum efficiences occur over a wide range of capabilities, and there is a value of head at which the turbine power output is zero even though there is flow through the unit. Cavitation can occur in turbines, just as in pumps, but may be prevented by maintaining sufficient outlet or back pressure. Before operating a pump as a turbine, a review of its design should include checking that threaded shaft components cannot loosen, evaluating the bearings, analyzing shaft stress, and checking the effect of increased pressure forces. For low-head applications, it is important to minimize the remaining energy after exit from the runner to maintain high efficiency. (Geiger-FRC)
W83-02030

MECHANICAL EQUIPMENT OF THE DEWATERING OUTLETS OF THE INGURI ARCH DAM,
I. F. Kochanov, and S. V. Farmakovskii.
Hydrotechnical Construction, Vol 15, No 12, p 729-739, December, 1981. 10 Fig, Translated from Gidrotekhnicheskoe Stroitel'stvo, No 12, p 13-19, December, 1981.

Descriptors: *Arch dams, *Dewatering outlets, *Mechanical equipment, Equipment, Engineering, Construction, Dams, Gates, Conduits, *USSR, Inguni arch dam.

The mechanical equipment of the dewatering outlets of the Inguri hydroelectric station was designed to absorb the static head and regulate the waste discharges at heads up to 181 m, and is unparalleled in design in Soviet and foreign construction practice. This equipment made it possible to dispense with the second level of outlets, whic provided considerable cost savings. The dewatering outlets, lined with metal and of round cross section for minimum weakening of the dam profile, are intended for diversion during filling of the reservoir, discharge of floodwaters, and drawdown of the reservoir. The mechanical equipment of the dewatering outlets icluded: a guard gate with embedded parts and a rod; bell-mouths with a diameter of 8.2/5 m; metal (regulating) gates; housings of the emergency-guard ring-follower gates; service (regulating) gates; housings of the emergency-guard gates and service gates; hydraulic drives of these gates; a 100/20-ton-capacity bridge crane; and other equipment. It was recently decided to install special flat crescent-shaped diaphragms in the exit sections of the outlets. The resulting design discharge of the outlets will be 465 cu m/sec each. (Baker-FRC)
W83-02087

8D. Soil Mechanics

PERCENTAGE SILT CONTENT IN SANDS AND ITS EFFECT ON LIQUEFACTION POTENTIAL,
Water and Power Resources Service, Denver, CO. Engineering and Research Center.
L. P. Kaufman.
Report, Decebember 1981, 171 p, 74 Fig, 8 Tab, 78 Ref. (M. S. Thesis, 1981, University of Colorado, Boulder, Dept. of Civil and Urban Engineering).

Descriptors: *Earthquakes, *Silt, *Sand, Liquefaction, *Soil dynamics, Soil physics, Cohesionless soils, Particle size, Uniformity coefficient.

The immense damage caused by soil liquefaction during earthquakes in 1964 greatly stimulated geotechnical engineers toward systematic studies of the phenomenon of earthquake-induced liquefaction of cohesionless soil deposits. The problem of the liquefaction potential of soils must also be taken into consideration in the design of earth embankment dams, mine tailings dams, nuclear power plants, bridge supports, waterfront structures, and large offshore structures. The liquefaction potential of reconstituted soil specimens was determined using the cyclic triaxial test. Four sand samples were prepared which differed from each other in respect to mean grain size and coefficients of uniformity. Measured portions of silt were mixed with each sand sample to result in test samples containing 10, 30, 60 and 100% silt. The results of the cyclic triaxial tests reveal that the liquefaction potential of those soil samples varies systematically and predictably. An increase in silt content is found to strengthen the sandy soil. The mean grain size and the coefficient of uniformity of the original sand samples appeared to have little or no effect on the cyclic shear resistance of the silty samples which were derived from them. (Moore-SRC)
W83-01885

SEISMIC RESPONSE OF EARTH DAMS IN TRIANGULAR CANYONS,
F. I. Makdisi, T. Kagawa, and H. B. Seed.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT10, p 1328-1337, October 1982, 11 Fig, 8 Ref.

Descriptors: *Dam stability, *Seismic properties, *Vibrations, *Earth dams, *Canyons, Embankments, Plane strain analysis, Strain measurement, Shear stress, Soil mechanics, Geophysics.

The effects of narrow and sloping canyons on the seismic response of embankment dams was studied using three-dimensional dynamic finite element analysis. Both triangular and rectangular canyon cross sections were considered. The results for several embankment width to height ratios were compared with plane strain solutions, and large differences were found between the two solutions. The natural frequencies for horizontal soil deposits in triangular sections with width to height ratios up to 5 were 40% higher than those computed from one-dimensional column studies. In deposits with a width to height ratio of 5 in rectangular canyons, the natural frequencies were within 5% of the one-dimensional solution. For embankments in triangular canyons the computed natural frequencies from three-dimensional analysis were 35% higher than those of plane strain solutions even for width to height ratios of 6 or more. For embankments with width to height ratios of 3 subjected to transient ground motions, the computed accelerations for the three-dimensional solution at the midsection were 60-80% higher than those of the plane strain response; computed shear stresses were half those of the plane strain analysis. Smaller differences were found at the quarter section, depending on the height of the embankment, width of the canyon, and frequency content of the input base motion. Three-dimensional analysis was more useful and accurate than the plane strain assumption in predicting response of dams built in narrow and steep triangular canyons. (Cassar-FRC)
W83-01890

FILTER CRITERIA FOR GEOTEXTILE: RELEVANCE AND USE,
Lawson Consulting, Sydney (Australia).
C. R. Lawson.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT10, p 1300-1317, October, 1982. 13 Fig, 1 Tab, 23 Ref.

Descriptors: *Soil filters, *Textiles, *Dam design, Geofilters, Filters, Construction materials, Soil water, Materials testing, Soil piping, Permeability, Uniformity coefficient, Subsurface drainage, Drainage, Pore size, Particle size, Hydraulic properties.

A laboratory evaluation program established that existing geofilter criteria were valid in the case of an earthfill dam constructed on fly ash base where applied water heads at the ash-geotextile suface were large (up to 10.8 m). For optimal filter performance in one-directional filter applications two criteria must be met. After an initial period of instability during which formation of the soil filter occurs, the permeability of the system should remain constant, and no further in situ soil should be piped through the filter system. Several sets of criteria, consisting of empirical relationships have been developed to evaluate a system. Most are concerned with piping, permeability, uniformity, pore size of the geotextile and/or soil particle size. Results of different methods are in general agreement on the choice of the preferred geotextile. A geotextile's mechanical properties must also be considered so that rupture does not occur during installation or during the service life of the structure. (Cassar-FRC)
W83-01930

SHALLOW FOUNDATIONS IN COLD REGIONS: DESIGN,
Hardy Associates Ltd., Edmonton (Alberta).
E. C. McRoberts.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT10, p 1338-1349, October, 1982. 5 Fig, 31 Ref.

Descriptors: *Foundation, *Cold weather construction, *Design criteria, Soil mechanics, Construction, Frozen ground, *Reviews, Geothermal studies, Thaw, Structural settlement, Creep, Ice, Adfreezing, *Permafrost, Frost heaving, Frost protection.

A review of the North American literature concerning techniques for design of shallow foundations in permafrost considers geothermal aspects, thaw settlement and consolidation effects, frost heaving, and frozen ground aspects. The purpose of this paper is to overview the major factors to consider in design and provide a bibliography as a source of further information. The builder must consider the degree of frost in the region: seasonal frost, discontinuous permafrost, or continuous permafrost. Several analytical methods are available for studying conduction, the dominant mode of

heat transfer. Testing techniques for thaw settlement and thaw consolidation are available. Three basic approaches in design of shallow foundations for frost heave are: (1) prevention by a geothermal design that inhibits frost penetration, (2) prediction by empirical techniques to ensure that the structure can tolerate the probable heave, and (3) design to resist frost heaving by accounting for adfreeze forces. Footing size may be determined after consideration of frozen ground characteristics: strength, creep, and settlement. Tools for predicting adfreeze frost heave and frost jacking loads are not as well developed as other design techniques. (Cassar-FRC)
W83-01931

OBSERVATIONS OF THE STABILITY OF THE VALLEY WALLS OF THE SULAK RIVER NEAR THE CHIRKEY HYDROELECTRIC STATION,
G. D. Kuroshev, and V. N. Vlasenko.
Hydrotechnical Construction, Vol 15, No 12, p 725-729, December, 1981. 3 Fig, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 12, p 11-13, December, 1981.

Descriptors: *Measuring instruments, *Geological formations, *Valleys, Rivers, Earthworks, Sulak River, Arch dams, Dams, Construction, *USSR, Chirkey Hydroelectric station.

Deformations of the walls individual stretches of the valley of the Sulak River were found during surveys and construction in the valley of the 236-m-high arch dam and powerhouse of the Chirkey hydrostation. Potentially unstable masses on the walls were detected from the displacements of points of the third-order triangulation network, which served as the main geodetic base of construction, and from the data of geological surveys. The deformations of the masses were determined by geodetic methods. Various geodetic surveys, instruments, and measurement methods were used, which made it possible to obtain quantitative characteristics of the deformations of the walls. Analyzing the results of the geodetic measurements yielded operative information about the reliability of the anchor support of the left-bank slope. One of the important processes involved in setting up observations of the stability of valley walls is the selection of the initial control points, whose stability should be checked periodically. The polar method with the use of the MSD-1 optical rangefinder showed itself to be a most progressive measurement method. Use of this method shortened the time of field measurements and office processing without loss of quality of the results obtained. (Baker-FRC)
W83-02085

THE DESIGN AND APPLICATION OF VERTICAL DRAINS,
A. Chalmers.
Civil Engineering (London), p 33, 34, 39, 40, September, 1982. 8 Fig.

Descriptors: *Drainage, *Vertical drains, *Design criteria, *Clays, Soil types, Soil characteristics, Soil properties.

The basic design approach for vertical drains is reviewed, with some of the more recent examples being considered in depth. When a clay soil is subjected to a load the equilibrium pore pressure is distributed, and the water in the voids between the clay particles tends to migrate, allowing the soil particles to be pressed together. One of the controlling geological factors in the rate of consolidation is the presence or lack in the clay soil of macro-sized features such as sand and silt layers, or laminations which can have a thickness of less than 1 mm. In the past 15 years some 50 vertical drain contracts have been carried out to consolidate clay soils under load. Various techniques have been used, including 150 to 600 mm diameter sand-drains, 65 mm diameter sandwicks, filter wrapped perforated plastic tubes, and band-drains. Over the past four years the latter technique has prevailed in soft ground conditions because of its economically proven effectiveness. Band-drains can also minimize construction time, since relatively high production rates are possible. Vertical drains are most frquently used for the purpose of accelerating the consolidation of soft compressible clays below embankments for highways, railways and airfields. (Baker-FRC)
W83-02094

8E. Rock Mechanics and Geology

ADDING A FIFTH UNIT TO IDAHO'S BROWNLEE DAM,
International Engineering Co., Inc., San Francisco, CA. Water Resources Div.
O. Hougen, and K. Runyan.
International Water Power and Dam Construction, Vol 34, No 7, p 15-18, July, 1982. 3 Fig.

Descriptors: *Intake gates, *Hydroelectric power, *Hydraulic turbines, Dams, Dam construction, Cooling water, Intakes, Electric powerplants, Rock mechanics, Turbines, Hydraulic design.

The fifth unit at the Idaho Power Company's Brownlee dam was installed in April 1980. A tunnel was built to convey water from the intake to the powerhouse. The intake structure had to be modified to handle a higher turbine discharge. Hydraulic analyses were carried out to see that operation of the fifth intake would not affect the hydraulic integrity of the forebay. Rock behavior was monitored during the construction and operation of the fifth unit to check and evaluate the stability of the excavation. There are no indications of excessive vibration or damage to the trashrack since the unit began operation. Flow conditions in the tailrace have been better than expected, and initial minor problems with the data acquisition system and the oil cooling system for the thrust bearing have been corrected. (Geiger-FRC)
W83-01846

8G. Materials

EVALUATION OF FILTER FABRICS FOR USE IN SILT FENCES,
For primary bibliographic entry see Field 5G.
W83-01830

GEOPHYSICAL LOGGING SUPPLEMENTS TELEVISION INSPECTIONS,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 7B.
W83-01834

WATER SYSTEM REHABILITATION WAS A TIMELY INVESTMENT,
For primary bibliographic entry see Field 6B.
W83-01835

FILTER CRITERIA FOR GEOTEXTILE: RELEVANCE AND USE,
Lawson Consulting, Sydney (Australia).
For primary bibliographic entry see Field 8D.
W83-01930

FACTORS AFFECTING THE PERFORMANCE OF DRAINAGE ENVELOPE MATERIALS IN STRUCTURALLY UNSTABLE SOILS,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
W. Dierickx, and H. Yuncuoglu.
Agricultural Water Management, Vol 5, No 3, p 215-225, 1982. 7 Fig, 2 Tab, 2 Ref.

Descriptors: *Fibers, *Drainage envelopes, *Materials testing, Soil water, Coconut fibers, Polystyrene balls, Head loss.

Drainage envelope materials (coconut fibers, synthetic fibers with coarse pores, needled synthetic fibers with fine pores, and polystyrene balls in perforated polyethylene sheet) were subjected to flow tests in vertical columns filled with unstable non-cohesive silt loam soil. Upward flow and 100 m column height were found most suitable for experiments. Initial moisture content of the soil was an important factor in envelope material performance. Dry aggregates were unstable upon wetting, while at an initial moisture content of 15%, aggregates broke down at increasing hydraulic gradient. Most stable soil aggregates were at initial moisture contents of 17.5-20%, above which aggregates weakened and became more sensitive to compaction. No head losses were observed at 3% initial soil moisture in coarse-textured synthetic fibers or polystyrene balls or at 15% initial soil moisture in coconut fibers and coarse synthetic fibers. Slight head losses were seen at 3% initial soil moisture in coconut fibers and fine-textured synthetic fibers and at 15% in fine-textured synthetic fibers and polystyrene balls. The best envelope material for this particular soil was coarse-textured synthetic fibers. (Cassar-FRC)
W83-02018

WHAT TYPE SEWER PIPE IS BEST. LIFE-CYCLE COST ANALYSIS YIELDS ANSWER,
Camp, Dresser and McKee, Inc., New York.
T. Moss, and E. J. Jankiewicz.
Civil Engineering (New York), Vol 52, No 10, p 75-76, October, 1982. 1 Fig.

Descriptors: *Pipes, *Construction, *Cost analysis, Economic aspects, Pipelines, Conveyance structures, Plumbing, Concrete, Steel, Materials.

Sewer pipe is now selected on a life-cycle-cost basis in Winchester, Virginia. The pipe which is selected for use is the one which promises to save money over the long term. The key to this approach is to look at the long-term costs over the anticipated lifetime of a sanitary or storm sewer, not to look only at the initial costs. Using a present worth technique, a comparison is made of the costs that would result from using different pipe materials, figuring all costs over the lifetime of various pipes. Pipe life varies with the pipe material and the application to which it is put. The lifespan of each material changes from site to site. In each case one must consider the special circumstances, including soil acidity, resistivity, and water conditions. (Baker-FRC)
W83-02096

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

WATER QUALITY INVENTORY AND MONITORING PROGRAM FOR THE COMMONWEALTH OF VIRGINIA: STATE-OF-THE-ART,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
C. E. Parker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-167528, Price codes: A03 in paper copy, A01 in microfiche. Virginia Water Resources Research Center Report, Virginia Polytechnic Institute and State University, Blacksburg, August 1982. 40 p, 1 Fig, 1 Tab, 2 append. OWRT A-098-VA(1).

Descriptors: Water quality, *Water resource information, Inventory, *Monitoring, *Data collection, Water quality data collection, *Information dissemination, *Data storage and retrieval, *Virginia, *Surveys, Texas.

A state-of-the-art survey of water quality inventory and monitoring programs in Virginia was made to establish the needs and sense of direction the Commonwealth should take concerning the collection and dissemination of water quality information. Inquiries outside the Commonwealth were made to satisfy the need to know what other state agencies and interstate commissions have done or are doing in the area of water quality information systems. Results indicate that a variety of data storage and retrieval systems have gained some use in the Commonwealth. Although each institutional and political entity has gone on its own to satisfy

some minimal need, the importance of a water resource information system with the ability to pull together information that can be accessed through one terminal or telephone call, is recognized. Most data information systems that have emerged in Virginia are the result of some cooperative effort with a federal agency. Commonwealth Data Base may be the beginning of a broad data information system that can become a part of a water resource data management system. It appears that Texas has established a system that can serve as a model for Virginia. The Texas Natural Resources Information System acts as a clearinghouse between state agencies. Part of its function is to catalogue and make accessible water resource information.
W83-01949

10F. Preparation Of Reviews

ATLAS OF THE SPAWNING AND NURSERY AREAS OF GREAT LAKES FISHES; VOLUME XIV, LITERATURE CITED,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. D. Goodyear, T. A. Edsall, D. M. O. Dempsey, G. D. Moss, and P. E. Polanski.
Report FWS/OBS-82/52, September 1982, 150 p, 2175 Ref. NCE-IS-78-30.

Descriptors: *Spawning, *Fish, *Aquatic habitats, *Distribution, *Bibliographies, *Great Lakes, Fish nursery, Fish eggs, Fisheries.

This bibliography lists the literature cited in Volumes I-XIII of this atlas of fish spawning and nursery areas. In the preparation of the atlas it was found that support (or supported) major recreational or commercial fisheries, or that are or were major components of the forage base; conversely, relatively little information was available for many other species not included in these general categories. (Moore-SRC)
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VOLUME 16, NUMBER 7
JULY 1983

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 16, NUMBER 7
JULY 1983

W83-02101 -- W83-02450

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Directory of the Office of Management and Budget through September 30, 1983.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

PREDICTING PEAK STREAM FLOW FROM AN UNDISTURBED WATERSHED IN THE CENTRAL APPALACHIANS,
M. S. Brewer, R. Lee, and J. D. Helvey.
Water Resources Bulletin, Vol 18, No 5, p 755-759, October, 1982. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Rainfall intensity, *Hydrologic models, *Flood peak, Rainfall-runoff relationships, Model studies, Streamflow, Rainfall duration, Precipitation intensity, Runoff, Hydrographs, West Vrginia, Appalachian region, Forest watersheds.

Rainfall and streamflow data from a small forested catchment in West Virginia were used to model peak streamflow as a function of hydrologic variables. Data from 112 storms were chosen from snow-free periods during the 1952-78 record. Only storms with single peaked hydrographs and continuous rainfall were used. All parameters were extremely variable. Antecedent rainfall and storage were excluded as significant variables, and 1, 2, and 3-variable models were tested. The 2-variable models (rainfall depth and initial flow rate) and 3-variable models (rainfall depth, initial flow rate, and rainfall duration) underestimated the larger peak flows. An attempt to improve the basic models using expressions of rainfall intensity (temporal sequence of intensity and maximum intensity) was not effective. The most intense rainfall generally occurred in the earliest part of the storm. Mean rainfall intensity for an entire storm was generally as useful as shorter interval intensities. (Cassar-FRC)
W83-02150

ASSESSING THE EFFECT OF SPATIAL PATTERN OF PRECIPITATION IN MODELING STREAM FLOW HYDROGRAPHS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. J. Beven, and G. M. Hornberger.
Water Resources Bulletin, Vol 18, No 5, p 823-829, October 1982. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Hydrologic models, *Spatial distribution, *Rainfall distribution, *Rainfall-runoff relationships, Model studies, Precipitation, Streamflow, Hydrogrpahs, Storms, Rainstorms, Catchments, Friends Creek, Goose Creek, *Illinois.

Data collected in July and August 1979 from two intensive rainfall recording experiments in Goose and Friends Creeks basins, Illinois, were use to study the effects of rainfall spatial distribution on stream hydrographs for summer convective storms. Threshold analysis showed that the available sample size was not sufficient to discern the effects of spatial variability. Therefore, a deterministic/stochastic modeling approach was then used to generate storms of different patterns (1000 summer storms representing 75-100 years) to find the aspects of catchment response most likely to be affected by spatial variability. Differences in peak timing resulting from the different patterns were highly significant, differences in distributions of peak flow were significant, and differences in distributions of storm flow volumes were insignificant. In a highly variable spatial pattern the most important factor in predicting stream hydrographs was the correct volume of input. Rainfall pattern itself had only a secondary effect on hydrograph characteristics. (Cassar-FRC)
W83-02152

DETERMINING RAINS OF HYDROLOGIC CONSEQUENCE IN CHICAGO FOR FORECASTING APPLICATIONS,
Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Water Resources Bulletin, Vol 18, No 5, p 857-861, October, 1982. 5 Tab, 14 Ref.

Descriptors: *Urban runoff, *Storm water, *Overflow, *Chicago, *Illinois, Precipitation, Runoff, Water management, Storm-overflow sewers, Hydrometeorology, Meteorology, Rainfall distribution, Storms, Storm sewers, Flooding, *Weather forecasting.

Analysis of rainstorm data in the Chicago, Illinois, area indicated that undesirable storm runoff into Lake Michigan was produced by rains exceeding 2 inches in a few hours. Since 1947 there have been 139 storms of = or > 2 inches and 34 overflows. Three of the overflows occurred with storms < 2 inches. Although the number of 2 inch storms per 5-year period has varied randomly from 14 to 26, the number of overflows per 5-year period increased from 3 for each 5-year period for 1948-1971 to 6 in 1972-76 and 13 in 1977-81. Failure to forecast runoff or to operate the storm water system properly occurred most often in spring and fall in the past and in June and July more recently. Analysis of the distribution of storms in north (produces greatest problems), central, and south sections of the basin showed no statiscally significant differences over the 35-year period. Changes in land use have been minimal during the past 10 years. The Chicago Hydrometeorological Area Program is capable of predicting short duration > 2 inch rainstorms 2 hours in advance with 80% accuracy. Since other causes of overflows have not been identified, it is possible that use of this predictive method can aid in better storm runoff management by lowering the volume in the system in advance of a storm. (Cassar-FRC)
W83-02167

APPLICATION OF QUANTITATIVE GEOMORPHIC ANALYSIS TO THE GEOGRAPHIC BASINS OF PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Geography.
N. Liberatore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177980, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 102 p, 28 Fig, 49 Tab, 9 Ref. OWRT A-060-PR(1), 14-34-0001-1141.

Descriptors: Geomorphology, *Drainage systems, *Drainage basins, Hydrogeology, Drainage density, River systems, Puerto Rico, Tallaboa River basin, *Network design.

This investigation was performed with the purpose of implementing in Puerto Rico the investigation of geomorphic factors that characterize drainage systems and to elucidate and interpret the relationship between geologic-structural conditions and the hydrologic characteristics. The area selected as the sample was the Tallaboa river basin, because of its peculiarity of the distribution of its surface rocks and because of the availability of hydrologic information for the area. In order to accomplish the investigation the hydrographic network obtained from aerial photographs was designed and systematically transferred to the topographic base represented by the U. S. Geological Survey (U.S.G.S) maps at a scale of 1:20,000. The hydrography was successively classified based in the order of confluence of the different river reaches. The morphometric parameters, represented by the frequency, length, slope and perimeter of each basin, were calculated for the subbasins in which the area was subdivided as well as for the entire basin. Other parameters calculated were: branching rate; number, density, and index of hierarchical anomalies; the permanence constant of the reaches; circularity and elongation ratio; the relief ratio; the drainage density; and the length of the drainage and its form. (Munoz, Puerto Rico)
W83-02213

IMPROVING WATERSHED-MODEL ACCURACY BY USING DIGITAL TOPOGRAPHY,
West Virginia Univ., Morgantown. Water Research Inst.
R. N. Eli, and M. J. Paulin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178137, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, 1983. 57 p, 28 Fig, 6 Tab, 14 Ref. OWRT A-046-WVA(1), 14-34-0001-1152.

Descriptors: *Computer models, *Hydrograph analysis, Model studies, *Simulation analysis, *Terrain analysis, *Topography, *Watersheds, Basins, Digital computers, Hydrographs, Mathematical models, Statistical models, Synthetic hydrology, Unit hydrographs.

An 11 square-mile watershed was modeled using three different resolution-triangulated digital-terrain models. The number of triangular elements varied from 176 to 784. The objective was to test the sensitivity of a distributed unit-hydrograph model to changing element size. Each triangular element and stream segment was modeled as a sequential linear-reservoir/linear-channel element. It was determined that the overland-flow elements (the triangular elements) were relatively insensitive to lag-time proportioning, while the stream segments were relatively sensitive. The lack of sensitivity in overland flow is explained by the relatively steep watershed topography and the resulting short lag time of overland flow as compared to stream lag. A 50 to 75% weighting toward linear-channel lag contribution yielded similar output results for each resolution level, and seemed logically consistent with the physical characteristics of the watershed. It was concluded that use of a distributed linear-reservoir/linear-channel model, in conjunction with a triangulated digital terrain model, does not require a high resolution representation (i.e., many triangles) to yield acceptable results.
W83-02233

PARAMETER ESTIMATION OF MULTIPLE INPUT-OUTPUT TIME SERIES MODELS: APPLICATION TO RAINFALL-RUNOFF PROCESSES,
Princeton Univ., NJ. Dept. of Civil Engineering.
D. M. Cooper, and E. F. Wood.
Water Resources Research, Vol 18, No 5, p 1352-1364, October, 1982. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Hydrologic models, *Time series analysis, *Streamflow forecasting, *Model studies, Rainfall-runoff relationships, Parametric hydrology, Runoff, River flow, Tributaries.

In time series modeling of hydrologic systems the model structure either is determined a priori from physical considerations or is identified statistically. This paper sets forth a maximum likelihood procedure for estimating the parameters of a class of statistical models (linear time-invariant state-space) once a suitable member of the class has been identified. Using the innovation form of the state-space model, the parameters of the transition, input weighting, gain and output, or measurement matrices are estimated as well as the innovation covariance matrix. Procedures for estimating process and measurement covariances in the state-space model, and the parameters of the equivalent multivariate autoregressive moving average with exogenous inputs (ARMAX) model are also developed. A convergent and asymptotically efficient on-line method of estimation is derived from the off-line algorithm. Four examples are presented: daily rainfall-runoff forecasting, four-site monthly streamflow, seasonal model, and river flow input-output model with a tributary. (Author abstract)
W83-02278

CHOOSING AMONG HYDROLOGIC REGRESSION MODELS 2. EXTENSIONS TO THE STANDARD MODEL,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. B. Valdes, G. J. Vicens, and I. Rodriguez-Iturbe.
Water Resources Research, Vol 16, No 3, p 507-516, June, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Hydrologic models, *Regression analysis, *Model studies, Floods, Annual floods, Flow, Streamflow, Rainfall-runoff models.

An extension of the use of posterior probabilities as a criterion for discriminating among alternative hydrologic regression models is presented. The Bayesian discrimination procedure was used in several experiments in which the covariance matrix of

the disturbances did not have scalar form. Experiments included both synthetic and real data in regression that relate the mean annual flows and floods with the meteoroligical and physiographic basin characteristics. The procedure proposed in this paper places the highest posterior probabilities on the correct models, showing that Bayesian discrimination is useful in choosing alternative models and as a complement to traditional measures of performance. (Cassar-FRC)
W83-02279

SOIL-VEGETATION-HYDROLOGY STUDIES, VOLUME II, A USER MANUAL FOR ERHYM: THE EKLAKA RANGELAND HYDROLOGY AND YIELD AND MODEL,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
J. R. Wight, and E. L. Neff.
Agricultural Research Results ARR-W-29, January 1983. 42 p, 5 Fig, 17 Ref, 1 Append.

Descriptors: *Hydrologic models, *Rangelands, *Soil water, *Runoff, *Soil-water-plant relationships, *Vegetation, Model studies, Climate, Snowmelt, Evapotranspiration, Range management, Simulation, Infiltration.

The Ekalaka Rangeland Hydrology and Yield Model (ERHYM) was developed to simulate runoff and herbage production for northern Great Plains rangelands. It is a range site scale model that provides daily simulation of runoff, soil water evaporation, transpiration, and soil water routing. Herbage yield is computed annually at peak standing crop. The model can use real-time climatic data to simulate ongoing processes, or it can utilize historical climatic data to simulate runoff and herbage production under a range of climatic conditions and management practices. It can run either on a seasonal basis, with new soil water boundary conditions required at the beginning of each year's growing season, or continuously, utilizing a simple snowmelt-temperature relationship to account for snowmelt infiltration and runoff. This users manual contains the model description, model documentation, input and output parameters, and an example of model use in which model output is compared with field measured data. (Moore-SRC)
W83-02314

THE TURNING BANDS METHOD FOR SIMULATION OF RANDOM FIELDS USING LINE GENERATION BY A SPECTRAL METHOD,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. Mantoglou, and J. L. Wilson.
Water Resources Research, Vol 18, No 5, p 1379-1394, October, 1982. 12 Fig, 2 Tab, 30 Ref.

Descriptors: *Stochastic hydrology, *Hydrologic models, *Turning bands method, *Monte Carlo method, Model studies, Simulation analysis, Groundwater movement, Mass transfer, Rainfall-runoff relationships.

The turning bands method (TBM) for simulation of multidimensional random fields is described. Random fields often occur in the Monte Carlo simulation of hydrologic processes such as groundwater flow, mass transport, and rainfall-runoff models. The basic concept of the TBM is to transform a multidimensional simulation into the sum of a series of equivalent unidimensional simulations. This paper concentrates on the two-dimensional stationary process, which is more complicated than the one- or three-dimensional processes. For stationary two- dimensional fields the unidimensional line process is generated by simple spectral methods. The TBM is shown to be ergodic even for a finite number of lines. It rapidly converges to the true statistics of the field. Guidelines are given to help select model parameters helpful in the design of simulation experiments. TBM is as accurate as but much less expensive than the multidimensional spectral techniques and more accurate than the expensive appproaches using matrix inversion. (Cassar-FRC)
W83-02337

COMPARISON OF ESTIMATORS OF STANDARD DEVIATION FOR HYDROLOGIC TIME SERIES,
Geological Survey, Reston, VA.
G. D. Tasker, and E. J. Gilroy.
Water Resources Research, Vol 18, No 5, p 1503-1508, October, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Estimating, *Time series analysis, Model studies, *Monte Carlo Method, Mathematical studies.

A set of Monte Carlo experiments was carried out to compare five estimators of standard deviation of a serially correlated hydrologic time series. Three methods provided estimates of the standard deviation which were much less biased but had greater mean square errors than the usual estimate. The three methods may be briefly characterized as a method using a maximum likelihood estimate of the unbiasing factor, a method using an empirical Bayes estimate of the unbiasing factor, and a robust nonparametric estimate of the standard deviation. (Baker-FRC)
W83-02346

ESTIMATION OF PEARSON TYPE 3 MOMENTS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
U. Lall, and L. R. Beard.
Water Resources Research, Vol 18, No 5, p 1563-1569, October, 1982. 5 Fig, 7 Tab, 13 Ref.

Descriptors: *Floods, *Frequency distribution, *Statistical models, Mathematical studies, Model studies, Hydrologic equation.

Estimates of frequencies of floods and other events are based on statistical distributions estimated from sample data. The most common and generally the most robust technique used is the fitting of data by the method of moments. The study described examines the fact that all of such work has been based on considering the variation of statistics of various samples drawn from a specified population, whereas the real interest is in the range of likely parent population parameters corresponding to a statistic obtained from a unique sample with regard to a particular functional form of parent distribution and for the case where the a priori distributions of the parameters are uniform, that is, where all values of a particular parameter are equally likely on an arithmetic scale. The distribution function studied is the Pearson type 3, and the parameter of primary attention is the skew coefficient. (Baker-FRC)
W83-02353

2B. Precipitation

DISTRIBUTION AND STOCHASTIC GENERATION OF ANNUAL AND MONTHLY PRECIPITATION ON A MOUNTAINOUS WATERSHED IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson.
Water Resources Bulletin, Vol 18, No 5, p 875-883, October, 1982. 6 Fig, 7 Tab, 20 Ref.

Descriptors: *Watersheds, *Seasonal variation, *Distribution patterns, Precipitation gages, Reynolds, Creek, *Idaho, Mountains, Snow, Hydrology, Elevation, Simulation analysis, Gaging stations, Stochastic hydrology, *Spatial distribution, Areal precipitation, Local precipitation, Cyclonic precipitation, Precipitation.

The spatial distribution of annual and monthly precipitation was determined using 18 years of data collected from the dense gage network (38 sites) on the Reynolds Creek Experimental Watershed, Idaho. Most of the winter storms, cyclonic in nature, move over the watershed from the west to southwest. Heaviest precipitation is on the west (downwind) side of the watershed. Grouping the gaging sites into upwind and downwind produced two separate lines on the annual precipitation vs. elevation graph. Downwind stations had about 300 mm of average annual precipitation vs. elevation graph. Downwind stations had about 300 mm of average annual precipitation at 1200 m elevation and 1100 mm at 2200 m; upwind stations, 250 mm at 1300 m and 800 mm at 2200 m. Maximum annual precipitation was found just leeward of the western watershed boundary. Results of simulation of 50 years of annual precipitation data using the log-normal two-parameter distribution for 4 gage sites were within 2-16% of measured values. The monthly precipitation-elevation relationship was also best represented by separating the sites into upwind and downwind groups. During summer, when local thrunderstorms were the main source of precipitation and some months were altogether dry, results for upwind and downwind stations were combined. During the summer months there was a small precipitation increase with increase in elevation compared with winter. Monthly precipitation at all locations was simulated satisfactorily by the cube root-normal distribution. Simulated results for 50 years at four sites were close to measured results, the greatest difference being 7%. (Cassar-FRC)
W83-02154

VARIABILITY OF PRECIPITATION IN THE PACIFIC NORTHWEST: SPATIAL AND TEMPORAL CHARACTERISTICS,
Portland State Univ., OR. Dept. of Geography.
D. M. Johnson, and J. O. Dart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175232, Price codes: A15 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-77 (2 Vol), Oregon State University, Corvallis, May 1982. 327 p, 23 Fig, 7 Tab, 124 Ref, 5 Append. OWRT A-050-ORE(2).

Descriptors: *Precipitation, *Precipitation variability, *Pacific Northwest, Oregon, Washington, *Precipitation statistics, Precipitation trends, *Precipitation patterns, Data collections, *Temporal distribution, *Spatial distribution, Climatology, Climatic data, *Seasonal variation, *Annual distribution.

Spatial and temporal aspects of precipitation in the Pacific Northwest were analyzed for natural variability. The data base consists of monthly, seasonal and annual totals of precipitation for 244 climatological stations in Oregon, Washington and adjacent areas. A complete set of descriptive and inferential statistics was calculated and is presented in tabular form. Maps of key statistics—means, coefficients of variation and interstation correlation coefficients--depict spatial patterns. The 40-year normal period is shown to be sufficient for making probability estimates of seasonal and annual precipitation. Temporal variability in seasonal and annual precipitation over the last 100 years is studied with 70 long-term stations in Oregon and Washington. Trends, linear and non-linear, are determined and show that the spatial variation in temporal changes is great. There is little evidence to suggest either a progressive increase or decrease in annual precipitation in Oregon over the last century. In Washington there has been a tendency for decreasing amounts of annual precipitation. Changes over shorter time periods are also analyzed. The one persistent temporal pattern throughout the region is a downward trend extending from the 1890's to about 1930 and a gradual recovery in recent decades. However, there are many local variations of this pattern. The decade of the 1970's is marked by extremely high interannual variability, a finding consistent with studies from all parts of the globe.
W83-02178

EFFECT OF THE ENERGY OF RAIN ON ITS INFILTRATION INTO SOIL,
Mowcow Inst. of Land-Management Engineers (USSR).
For primary bibliographic entry see Field 2G.
W83-02249

PRECIPITATION CHARACTERISTICS AFFECTING HYDROLOGIC RESPONSE OF SOUTHWESTERN RANGELAND,

Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
H. B. Osborn.
Agricultural Research Service, Agricultural Reviews and Manuals ARM-W-34, January 1983. 59 p, 44 Fig, 8 Tab, 57 Ref.

Descriptors: *Rangeland, *Precipitation, Model studies, *Rainfall intensity, Distribution, Areal precipitation, Thunderstorms, *Convective precipitation, Variability, *Depth-area-duration analysis, New Mexico, Arizona.

This publication provides an up-to-date and definitive source of precipitation data for ranchers and others involved in range management and range renovation programs. The period of record (25 years) is such that specific probabilities now can be assigned to rainfall occurrences on an areal basis to provide a good estimate of the change of success or failure of any range management or renovation program as well as expected amounts of rainfall in a given basin for downstream water users. Early efforts were primarily to identify the unusual features of summer convective rainfall and show the variability in time and space. A complimentary effort was to develop seasonal and annual means and ranges of precipitation along with the spatial variability in such values. Point-to-area and depth-area-frequency relationships have been developed which can be used in similar climatic regions. Efforts to develop precipitation models have included revision or improvement in methods or models that were not originally designed for use in areas where the climate is dominated by thunderstorm rainfall, as it is in the Southwest. (Moore-SRC)
W83-02316

STOCHASTIC DAILY PRECIPITATION MODELS, 2. A COMPARISON OF DISTRIBUTIONS OF AMOUNTS,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
D. A. Woolhiser, and J. Roldan.
Water Resources Research, Vol 18, No 5, p 1461-1468, October, 1982. 7 Tab, 17 Ref.

Descriptors: *Stochastic hydrology, *Precipitation, *Model studies, Rainfall, Stochastic process, Mathematical studies, Rainfall intensity, Rainfall rate, Rainfall distribution.

Chain-dependent and independent exponential, gamma, and mixed exponential distributions are compared as models for the distribution of daily precipitation. Parameters for each distribution are estimated by maximum likelihood techniques for 14 day periods. The Akaike information criterion is used to select the most appropriate distribution for each period and for the entire year. For the five U. S. stations studied, the independent mixed exponential distribution was the best on the basis of the Akaike information criterion, and the independent gamma and chain-dependent gamma ranked second and third, respectively. Fourier series are fit to the parameters by least squares to provide starting values for subsequent numerical maximum likelihood estimates of the Fourier coefficients. According to the Akaike information criterion, the Fourier series description of model parameters for the mixed exponential model is superior to the specification of parameters for each 14 day period. (Baker-FRC)
W83-02341

STOCHASTIC DAILY PRECIPITATION MODELS. I. A COMPARISON OF OCCURENCE PROCESSES,
Cordoba Univ. (Spain). Catedra de Hidraulica General y Agricola.
J. Roldan, and D. A. Woolhiser.
Water Resources Research, Vol 18, No 5, p 1451-1459, October 1982. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Stochastic hydrology, *Model studies, *Precipitation, Rainfall, *Stochastic process, Mathematical studies, *Markov chain.

A first-order Markov chain and an alternating renewal process (ARP) with a truncated geometric distributions of wet day intervals and truncated negative bionomial distribution of dry day intervals are compared as models describing the occurence of sequences of wet and dry days. Numerical optimization techniques are used to obtain approximate maximum likelihood estimates of the Fourier coefficients which describe the seasonal variation of the two Markov chain parameters and the three parameters in the alternating renewal process. The likelihood functions for the ARP were not significantly greater than those for the Markov chain, and the Markov chain resulted in the minimum Akaike information criteria for the four rainfall stations that were compared. Because the numerical optimization technique to estimate Fourier coefficients by the method of maximum likelihood required considerably more computer time for the alternating renewal process than for the Markov chain, economic as well as statistical considerations suggest that the Markov chain model is superior for the stations considered for the record lengths of 20 to 25 years. The likelihood ratio test at the 0.01 level and the Akaike information criterion gave similiar results when used to determine the number of significant harmonics. (Baker-FRC)
W83-02342

MODIFIED SMEMAX TRANSFORMATION FOR FREQUENCY ANALYSIS,
Mosul Univ. (Iraq). Dept. of Irrigation and Drainage.
H. R. Rasheed, M. V. Ramamoorthy, and A. S. Al-Dabbagh.
Water Resources Bulletin, Vol 18, No 3, p 509-512, June, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Frequency analysis, *Precipitation, *Mathematical models, Rainfall, Probability distribution, Stationary process, Mathematical studies, Stochastic process, Statistical study, Model studies.

Estimates of floods and rainfall of specified frequency are often made through the use of a particular probability distribution function fitted to historical data. Instead of fitting a known distribution function to a set of hydrologic data, it is sometimes worthwhile to reconstitute the data by a suitable transformation so that the transformed data follows a particular distribution. Bethalmy (1977) suggested the SMEMAX transformation as a normalizing transformation to allow the normal distribution function to be used, thus simplifying the subsequent analysis. In the present work, an alternative and simpler form of the SMEMAX transformation is put forward which avoids the use of trigonometric functions. Transformed variables range from 0 to 100, and are near normally distributed. The simplicity of the modified SMEMAX transformation is demonstrated in its application to data of total annual precipitation at Baghdad. This modified form of the SMEMAX transformation should prove useful for practicing engineers involved in the design of hydraulic structures. (Geiger-FRC)
W83-02436

2C. Snow, Ice, and Frost

EFFECT OF VIEWING ANGLE ON THE INFRARED BRIGHTNESS TEMPERATURE OF SNOW,
California Univ., Santa Barbara. Dept. of Geography.
J. Dozier, and S. G. Warren.
Water Resources Research, Vol 18, No 5, p 1424-1434, October, 1982. 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Remote sensing, *Infrared imagery, *Snow surveys, Satellite technology, Brightness temperature, Albedo, Emissivity, Temperature.

Remote sensing of snowpack temperatures from satellites requires knowledge of the spectral emissivity of snow. A model for spectral emissivity is combined with the Planck function to calculate brightness temperature of snow in thermal infrared wavelengths for a range of grain sizes and viewing angles. Emissivity variations caused by density, grain shape, liquid water, and grain size are apparently unimportant, but emissivity varies with viewing angle to produce differences between thermodynamic temperature and brightness temperature as large as 3 K at wavelengths 23 to 14 microns, within the major atmospheric infrared window. This difference is also verified by experimental measurements. An equation to convert brightness temepratures to thermodynamic temperatures is presented, and this is also combined with a dual-wavelength atmospheric correction method. The spectral emissivity model is also used to calculate an 'all-wave' emissivity of snow: 0.985-0.990 for all grain sizes. (Author's abstract)
W83-02355

MODELING OF THE MELTING OF SNOW IN MOUNTAINS AND ARRIVAL OF WATER ON THE DRAINAGE BASIN SURFACE WITH THE USE OF SATELLITE INFORMATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
E. L. Muzylev, and L. K. Poplavskaya.
Water Resources, Vol 9, No 1, p 31-37, January/February, 1982. 2 Fig, 16 Ref. Translated from Vodnye Resursy, No 1, p 66-73, January/February, 1982.

Descriptors: *Snowmelt, *Satellite technology, *Streamflow forecasting, Melting, Snow cover, Snow accumulation, Runoff, Model studies, Watersheds, Gavasai River, *USSR, River basins, Mountains, Snowline, Hydrologic models, Remote sensing.

Satellite observations (1975-79) of the accumulation and melting of snow in mountains were used to model the formation of snow cover and runoff hydrographs for the Gavasai River basin in the Chaikal Range, USSR, drainage area 657 sq km. Snow cover was estimated from the photographs for five altitudinal zones: below 1200 m, above 3000 m, and three intermediate zones. Accuracies in determing snow cover were 6-10%; for snow line location, 150-300 m with respect to height. A model was developed to predict runoff at the basin outlet. Observed hydrographs did not match predicted values for all years. Actual discharges increased markedly at the end of March and beginning of April, whereas the model predicted the increase to occur in March. These differences were caused by neglect of infiltration and evaporation losses, the degree of saturation of the basin at the beginning of rainfall, and other consideration. However, it was possible to model the course of melting and formation of snow cover. (Cassar-FRC)
W83-02419

2D. Evaporation and Transpiration

COMMENT ON 'ESTIMATING EVAPOTRANSPIRATION FROM THE SONOITA CREEK WATERSHED NEAR PATOGONIA, ARIZONA' BY J. BEN-ASHER: AND REPLY BY AUTHOR,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Water Resources Research, Vol 18, No 4, p 1287-1291, August, 1982. 1 Fig, 27 Ref.

Descriptors: *Watersheds, *Evapotranspiration, *Estimating, Mathematical equations, Mathematical models, Model studies, Seasonal variations, Radiation, Net radiation, Hydrologic budget, *Arizona, Sonoita Creek watershed.

In this comment on the cited research (Water Resources Research, Vol 17, p 901-906, 1981) the author suggests several areas of concern in the equations used for estimating evapotranspiration from this area of study. Note is taken of the fact that CRAE-1975 (complementary relationship areal evapotranspiration) models do not take into account the seasonal changes in net radiation that occur as the ground dries. The error analysis as presented grossly overestimates the effects of the aforementioned changes in net radiation. The author of the original work responds by stating that the CRAE formula simplifies a complex soil-plant atmosphere continuum phenomenon and is therefore subject to criticism, particularly by meteorologists. However, it can be supported by hy-

drologists and soil physicists, as it can give estimates of areal evapotranspiration as accurately as any other available method. (Baker-FRC)
W83-02144

EVAPOTRANSPIRATION ESTIMATES BASED ON SURFACE TEMPERATURE AND NET RADIATION: DEVELOPMENT OF REMOTE SENSING METHODS,
Florida Univ., Gainesville. Dept. of Agronomy.
K. F. Heimberg, L. H. Allen, Jr., and W. C. Huber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175307, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center Publication No. 66, Univ., of Florida, Gainesville, 1982. 210 p, 40 Fig, 8 Tab, 62 Ref, 4 Append. OWRT A-040-FLA(1), 14-34-0001-0110, 14-34-0001-1110.

Descriptors: *Evapotranspiration, *Remote sensing, *Net radiation, *Surface temperature, Satellite, Micrometeorology, *Energy balance, Regional evapotranspiration, Evapotranspiration models, *Florida, Air temperature, Temperature gradients.

A generalized method for making evapotranspiration estimates using satellite data is presented. It is designed for good cumulative ET estimates based on surface temperature, air temperature, and net radiation data of limited time resolution. The surface is described by an equation relating surface-to-air temperature gradients, net radiation, moisture availability, bulk air thermal conductivity, saturation deficit, and a soil heat flux parameter. Given estimates of two of these factors, the other two can be determined from the correlation of temperature gradients and net radiation. The parameters are then used in a Penman-type equation to calculate ET using net radiation measurements made over a pasture surface. The ground truth ET measurements were made with the energy budget-profile Bowen ratio technique.
W83-02185

2E. Streamflow and Runoff

BASE FLOW OF STREAMS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
R. J. Reynolds.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-257577, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-48, 1982. 33 p, 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Base flow, *Streams, *Surface-groundwater relations, Data collections, Stream gages, Flow duration, Stream discharge, Groundwater movement, Groundwater runoff, Drought, Sewer systems, Computer models, *Long Island, New York.

On Long Island, base flow under nonurbanized conditions constitutes 90 to 95% of total stream discharge. Base-flow data from 19 continuously gaged streams are presented as monthly mean and annual mean discharge for water years 1960-75, which includes the 1962-66 drought. The data were derived by hydrograph-separation procedures that isolate mean daily base flow from mean daily discharge. A close empirical relationship between annual mean base flow and stream discharge at the 55-% duration point facilities estimation of average base flow and can be used in place of the more time-consuming hydrograph-separation technique. These data are needed in calibration of computer models that will be used to predict the effects of hydrologic stresses, such as sewering, on the Long Island ground-water system. (USGS)
W83-02112

RECHARGE IN SEMIARID MOUNTAIN ENVIRONMENTS,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 2F.
W83-02137

EVALUATION OF DROUGHT POTENTIALS AND DAMAGES IN THE NORTHEASTERN UNITED STATES,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, and G. B. Emmanuel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173328, Price codes: A08 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, Pennsylvania State Univ., University Park, September 1982. 158 p, 23 Fig, 17 Tab, 1 Exhibit, 33 Ref, 3 Append. OWRT B-124-PA(1), 14-34-0001-1261.

Descriptors: *Drought, *Drought damages, *Reservoirs, *Groundwater recharge, Water demand, Streamflow, Damages, Base flow, Water quality, *Pennsylvania, *Drought potentials, Northeast, Shortage, Precipitation shortfall, Minimum low flow requirements, Damage functions, Yields, Hydrologic events, *Flow augmentation, *Low-flow augmentation, Dissolved oxygen.

Drought is an infrequent hydrologic event in the northeastern United States in which the availability of water for a variety of uses becomes restricted. It is herein defined in terms of the various uses for streamflow and the sum of the minimum low flow requirements for each. Regression equations were developed for selected low rates using data from streamflow gaging stations in Pennsylvania. An examination was made of damages incurred by Pennsylvania water suppliers during the 1980-81 drought. Drought damage functions were formed. As a means to avoid drought damages, an analysis was made of size and costs of reservoirs required to provide desired yields with and without some acceptable shortage levels. Augmentation of streamflow by groundwater recharge is discussed. A scheme is presented for causing recharge of high flows and stormwater runoff in off-stream channels or canals such that base flow is augmented as the percolating water moves downslope to the stream. The effects of low streamflows on water quality were investigated. It was determined that the diurnal fluctuations of dissolved oxygen increased substantially when discharge rates dropped below normal dry-weather flows. These large fluctuations could affect fishlife and increase the corrosive effects of industrially used water.
W83-02141

CLUSTER MODEL FOR FLOOD PEAK ANALYSIS: APPLICATION TO LOWER OHIO RIVER BASIN,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. E. Cervantes, M. L. Kavvas, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173344, Price codes: A09 in paper copy, A01 in microfiche. Technical Report 145, December 1982. 166 p, 30 Fig, 7 Tab, 32 Ref, 8 Append. OWRT B-112-IND(2).

Descriptors: Floods, *Statistical models, *Stochastic hydrology, *Stochastic processes, *Cluster models, *Ohio River Basin, Model studies, *Indiana, *Flood peak analysis, Rainfall clusters, Flood clusters, *Rainfall-runoff relationships.

A statistical model for the times of occurrence and the magnitudes of flood peaks is developed. The model is based on two-level and two-dimensional nonhomogeneous point stochastic process. The two levels correspond to the rainfall clusters and the flood clusters. The two dimensions are the times of occurrence (of the rainfall clusters or of the flood peaks) and the magnitudes (of the rainfall volumes or of the peak discharges). The statistical properties of the total number of flood peaks are developed in terms of the probability generating functional of the stochastic process. A statistical methodology is developed to estimate the two dimensional (time and magnitude) rates of occurrence of the precipitaton and of flood peaks. Data from several stations in Indiana were used for this purpose. The theoretical rate of occurrence, the theoretical covariance density and the probability mass function of the process are compared to the empirical rate of occurrence, the empirical covariance density and the empirical probability mass function of the flood data. The results of this statistical comparison are satisfactory for the analyzed stations.
W83-02143

THE MIXED GAMMA MODEL FOR CHANNEL LINK LENGTHS,
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams, and A. J. Miller.
Water Resources Research, Vol 18, No 4, p 1126-1136, August, 1982. 5 Fig, 5 Tab, 36 Ref.

Descriptors: *Channels, *Model studies, *Frequency distribution, Computers, Mixing, Slopes, Streams, *Link lengths, Mixed gamma density, *Mixing distribution.

An investigation made of the lengths of exterior and interior links in 12 disparate areas suggests that link length distributions for most, if not all, natural landscapes represent a mixture of link length populations from different parts of the landscape charcterized by different ground slope and/or environmental conditions. The mixed gamma density is derived for link lengths by assuming that both the component link length distribution for each relatively homogeneous part of the landscape and the mixing distribution of weights assigned to the various component distributions can be represented by gamma distributions. The mixed gamma density satisfactorily fits 84% of the 70 link length distributions examined, compared with 67% fitted by the log normal and 59% fitted by the gamma density. Diviations from the mixed gamma density are largely ascribed to spatial distributions of slope and environmental conditions which give rise to non-gamma-mixing distributions. (Baker-FRC)
W83-02145

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 6A.
W83-02147

EVALUATION OF THE REDUCTION OF THE VOLUME OF FLOW CARRIED BY CERTAIN RIVERS OF PUERTO RICO AND ITS POSSIBLE CORRELATION WITH CHANGES IN LAND USE, FROM 1508 TO PRESENT,
Puerto Rico Univ., Mayaguez. Dept. of General Engineering.
L. Pumarada-O'Neill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178004, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 54 p, 1 Fig, 2 Tab, 28 Ref, 2 Append. OWRT A-063-PR(1), 14-34-0001-0141.

Descriptors: *River flow, *Flow rates, *Land use, Urbanization, Land development, Runoff, Precipitation, *Puerto Rico, *Historical studies, *Statistical studies.

Historical evidence and oral accounts seem to indicate that there has been a significant reduction in the flow of many rivers in Puerto Rico. Several possible causes for this phenomenom have been mentioned, including the well documented, slight, but significant decrease in the average rainfall since the 1930's, the diversion of flow for irrigation and human water consumption, and the changes in land use that have taken place in the island. After an analyses of part of the existing historical evidence, which is found to be inconclusive, this paper undertakes a statistical study of available data for certain rivers in Puerto Rico. The hypotheses of the decrease in rainfall and in river volume of flow are tested, as well as the possible effect of land use changes in the basin upon the river's flow. The statistical analyses suggest that, within the period and basins studied, a decreasing precipitation may have cancelled an increasing proportion of run-off resulting from land use changes to avoid significant variations in volumes of flow.
W83-02215

REGIONAL ANALYSIS OF DROUGHTS IN SOUTH EASTERN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
M. F. Pedraja-Santos.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178020, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 28 p, 19 Fig, 2 Tab, 14 Ref. OWRT A-069-PR(1), 14-34-0001-1141.

Descriptors: *Droughts, *Hydrologic budget, *Meteorology, *Puerto Rico, *Regional analysis, *Time series analysis.

The time-series of stream flows for the five major streams in the area under consideration are presented in the study. Among them, only Rio Grande de Patilla's data corresponds to actual measured flows. All the other stream-flows were calculated from the average annual precipitation in the basin area. The average annual precipitation on the basin area was calculated using Thiessens method. In the case of the Rio de Maunabo stream the long-term annual mean flow was assumed for those years for which neither the stream flow or precipitation record was available. Thus, it was assumed that during those years there was no period of drought. For each stream the severity and magnitude of droughts are shown plotted against the exceedence probability. The long-term mean annual flow, the number of drought period of 'i' duration for each stream, the mean drought duration, mean failure probability and the 'i' year failure probability are shown in tables for each stream. According to the results the stream basin with the probabilty of having droughts of more than one year duration is the Rio Humacao basin, followed by the Rio Guamani and Rio Grande de Patillas basin. The latter had the greatest tendency of drought of 2-years to be extended or prolonged. The mean drought duration for the above basins are 3.07, 2.46 and 3.4 years respectively. (Munoz, Puerto Rico)
W83-02217

APPLICATION OF THE FINITE-ELEMENT METHOD TO CALCULATION OF UNSTEADY FLOW BY SAINT VENANT EQUATIONS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. K. Kantorovich, and L. S. Kuchment.
Water Resources (English Translation), Vol 8, No 6, p 584-591, November/December, 1981. 4 Fig, 7 Ref. Translated from Vodnye Resursy, No 6, p 45-53, November-December, 1981.

Descriptors: *Rivers, Flow, Mathematical equations, Model studies, *Saint Venant equation, *Finite element method, *Algorithm, *Unsteady flow.

An algorithm developed for numerical integration of Saint Venant equations on the basis of one of the modifications of the finite-element method in combination with Galerkin's method is presented. The results of using the algorithm when calculating unsteady flow in two river stretches whose water regime were calculated earlier by finite-difference methods are given. The calculations of the unsteady regimes on the Delaware and Tvertsa rivers and also a number of numerical experiments show that with respect to accuracy and expenditures of computer time the finite-element method is completely competitive with the most commonly used difference methods of solving Saint Venant equations, which provides realization of its advantages following from the physical formulation of problems of river hydraulics. (Baker-FRC)
W83-02246

SYNTHETIC STREAMFLOW GENERATION 2. EFFECT OF PARAMETER UNCERTAINTY,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and M. R. Taylor.
Water Resources Research, Vol 18, No 5, p 919-924, August, 1982. 3 Fig, 1 Tab, 27 Ref.

Descriptors: *Streamflow, *Stochastic hydrology, *Model studies, *Delaware River, Reservoir storage, Reservoir releases, *New York, Probabilities, Parameter uncertainty.

The impact of incorporating the uncertainty in the statistics describing the distribution of annual flows into the streamflow generation process was examined. Using the 50-year flow record for the upper Delaware River basin, the uncertainty in the mean, variance, and correlation of annual flows had significant effects on estimates of the reliability with which reservoirs of different capacities can meet a specified demand. In fact, these uncertainties produced variations of the same magnitude as obtained using different models. Without compensating for the variation in mean and variance of annual flows, probabilities were 2.6% (Thomas-Fiering model) and 8.6% (ARMA annual) that a 50-year drought would occur. Probabilities were 10.2% and 18.2% considering parameter uncertainty. (Cassar-FRC)
W83-02270

SYNTHETIC STREAMFLOW GENERATION 1. MODEL VERIFICATION AND VALIDATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and M. R. Taylor.
Water Resources Research, Vol 18, No 4, p 909-918, August, 1982. 3 Fig, 6 Tab, 45 Ref.

Descriptors: *Model studies, *Stochastic hydrology, *Streamflow, *Delaware River, Reservoir storage, Reservoir releases, *New York, Data verification, Data validation, Markov processes.

The performances of five monthly streamflow models were compared in the verification and validation of data for the upper Delaware River basin in New York State. A sharp distinction was made between verification (demonstration that a streamflow model produced flows with the specified characteristics of the selected distribution for river flow) and validation (demonstration that a streamflow model generates flow sequences producing reservoir system performance consistent with those generated from the historical flow record). The models included: Thomas-Fiering (1962) monthly Autoregressive Markov model, Autoregressive Moving Average (ARMA) monthly, Fractional Gaussian Noise (FGN) monthly, and the ARMA and FGN annual models using disaggregation to obtain monthly values. For each model the monthly and annual means, standard deviation, and skew coefficient of streamflow sequences are listed. (Cassar-FRC)
W83-02271

QUANTILE ESTIMATION WITH MORE OR LESS FLOODLIKE DISTRIBUTIONS,
Geological Survey, Reston, VA.
J. M. Landwehr, N. C. Matalas, and J. R. Wallis.
Water Resources Research, Vol 16, No 3, p 547-555, June, 1980. 2 Fig, 10 Tab, 12 Ref.

Descriptors: *Statistical analysis, *Flood frequency, *Distribution, Flood protection, Estimating, Wakeby distribution, *Gumbel distribution, Log normal distribution, Design floods.

Five techniques for determing flood distributions were used to determine the biases and mean square errors of the estimates of the upper quantiles for each of 6 Wakeby populations. These techniques were: Wakeby distributions with probability weighted moments; Gumbel distribution with probability weighted moments, maximum likelihood, and method of moments; and log normal with method of moments. Evidence that floods are distributed with long stretched upper tails suggested that use of the Gumbel and log normal consistently underestimated the extreme quantiles, resulting in underdesign of flood protection measures. None of the three Gumbel techniques performed consistently better than the other for all populations. The least underdesign was obtained with Wakeby distribution fitted by probability weighted moments. (Cassar-FRC)
W83-02273

A FREQUENCY DISTRIBUTION FOR ANNUAL FLOODS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton.
Water Resources Research, Vol 16, No 2, p 347-354, April, 1980. 8 Fig, 7 Tab, 6 Ref.

Descriptors: *Flood frequency, *Frequency analysis, *Statistical analysis, Flood recurrence, *Annual floods, *Australia, Distribution, Mathematical studies, Watersheds.

A distribution for frequency analysis of the logarithms of annual floods has been derived from data from 78 catchments in eastern Australia. The statistics of data from these catchments demonstrate the need for three-parameter distributions instead of two-parameter distributions for analysis of annual floods. A nonlinear relationship between frequency factor and ln ln (T/T-1) function of recurrence interval is demonstrated, and this relationship is used as the basis for the distribution. Methods of fitting the distribution to data sets, including sets which contain zero values, are described. A comparison is made of results from the new distribution, the log Pearson type 3, the log normal, the log Gumbel, and the Gumbel distributions. (Author's abstract)
W83-02276

ANALYSIS OF LENGTH DISTRIBUTION OF DRAINAGE BASIN PERIMETER,
California Univ., Irvine. School of Social Sciences.
C. Werner.
Water Resources Research, Vol 18, No 4, p 997-1005, August, 1982. 10 Fig, 18 Ref.

Descriptors: *Drainage basins, *Channels, Drainage, Basins, River basins, Water resources development, Topology, *Spatial distribution, Ridges, Mathematical equations, Maps, Model studies.

To establish a theoretical base for the study of the length distribution of basin perimeters, the paper introduces a descriptive model of the topology of interlocking channel and ridge networks. Assuming topological randomness within and between both, the expected number of links of basin perimeters is derived: for large basin magnitudes, n, it approximates a square root function in n. Observed link numbers of perimeters deviate significantly, showing a 0.69 regression exponent for their growth relative to the basin magnitude rather than the expected value of 0.5. The spatial constraint of possible perimeter/area to the 1/2 power proportions as defined by the circle is translated into a corresponding topological constraint but fails to provide a sufficient explanation. The possibility is then explored that the relatively large length of the perimeter reflects the basin elongation, which might be linked to the length of the mainstream. Although basin perimeter, elongation, and mainstream length are highly correlated and the elongation axis is oriented to the outlet in two-thirds of the sample basins, the data indicate that the mainstream link number does not account for the basin elongation, nor does it account for the number of links of the basin parimeter. (Author abstract)
W83-02287

A DERIVED FLOOD FREQUENCY DISTRIBUTION USING HORTON ORDER RATIOS,
Princeton Univ., NJ. Dept. of Civil Engineering.
C. Hebson, and E. F. Wood.
Water Resources Research, Vol 18, No 5, p 1509-1518, October, 1982. 7 Fig, 10 Tab, 32 Ref.

Descriptors: *Flood frequency, *Catchments, Catchment basins, Catchment areas, River basins, *Flood forecasting, Geomorphology, *Horton Order Ratios, Pennsylvania, Bald Eagle Creek watershed, Davidson River watershed, *Geomorphologic unit hydrograph, North Carolina, Appalachia Mountain region.

A flood frequency distribution is derived from assumed climatic distributions and the geomorphologic unit hydrograph model of catchment response. The derived distribution is tested on two Appalachian Mountain catchments and shows good agreement with historical data. Because the geomorphologic unit hydrograph (GUH) is rooted

in catchment shape and geomorphology, this derived frequency distribution may be a promising vehicle for studying the effect of catchment shape on flood frequency characteristics. Furthermore, it is suggested that the question of catchment homogeneity and similarity, necessary for regional flood estimation, can also be studied through the GUH derived flood distribution. (Baker-FRC)
W83-02347

A STUDY OF LOW FLOWS USING DATA FROM THE SEVERN AND TRENT CATCHMENTS,
J. Pirt, and J. R. Douglas.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 299-308, 1982. 5 Fig, 2 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Minimum flow, Severn River, Trent River, Flow duration, Runoff coefficient, River flow, Residual flow diagram, *England.

Three methods of describing low flow information are the residual flow diagram, the natural runoff map, and flow duration curves. Residual flow diagrams give a hydrological snapshot of a river for a particular flow condition. It can show how the flow at any point is composed in terms of natural and artificial components and can indicate water quality. River flows, water reclamation works discharges, abstraction returns, and trade effluent returns are used to prepare quantity and quality diagrams, which plot the flow against the kilometer point of the river for given flow conditions such as dry weather flow and minimum flow. 200 such diagrams are available for rivers and tributaries in the Severn-Trent Water Authority area. Runoff coefficients are obtained by dividing the net addition to natural runoff between any two points by the contributing catchment area between those points. The coefficients are depicted on maps for minimum and dry weather flow conditions for the Severn and Trent basins. Flow duration curves can assess the frequency distribution of flows at any site lacking gaged data, given the catchment area, mean annual effective rainfall, geological type, and soil index. (Cassar-FRC)
W83-02388

A STATISTICAL ANALYSIS OF THE DAILY STREAMFLOW HYDROGRAPH AND A PROBABILITY DISTRIBUTION OF THE INTERARRIVAL TIMES OF PEAK FLOWS-APPLICATION TO INDIANA,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
M. L. Kavvas, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187153, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 147, January 1983. 111 p, 41 Fig, 4 Tab, 24 Ref.

Descriptors: *Discharge hydrograph, *Stream discharge, *Probability distribution, Stochastic processes, Floods, Droughts, *Indiana, *Flood peak, Streamflows, Interarrival time.

A periodic analysis of the daily streamflows at five gaging stations in Indiana was performed to gain insight into the stochastic structure which governs the daily stream process. This analysis made use of the mean function and the covariance function of the daily streamflows as well as the probability distribution of the interarrival times between peak discharges and the probability distribution of the times to the peak discharges. It is shown that the daily streamflow process is annually periodic in all its statistic functions and that the persistence properties and the recession decay rates change with the state of the watershed storage and with time. An attempt was made to derive a theoretical probability distribution of the interarrival times between hydrograph peaks. These interarrival times and their probability distribution depend upon the time of the year and on the discharge exceedence level. The theoretical derivation is based on a stochastic trigger model of flood peaks. The derived distribution has limited success because of the averaging of the parameters over a relatively large interval of 15 days. It is believed that with a finer estimate of the parameter functions a better replication of the observed probability behavior would be obtained.
W83-02408

INVESTIGATION OF THE RELATION BETWEEN THE HYDROCHEMICAL AND HYDROLOGICAL REGIMES OF RIVERS OF THE AMUR BASIN,
For primary bibliographic entry see Field 2K.
W83-02442

2F. Groundwater

DIGITAL MODEL OF PREDEVELOPMENT FLOW IN THE TERTIARY LIMESTONE (FLORIDAN) AQUIFER SYSTEM IN WEST-CENTRAL FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. D. Ryder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-245804, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-54, 1982. 61 p, 17 Fig, 5 Tab, 44 Ref.

Descriptors: *Computer models, *Flow, *Aquifer systems, *Groundwater, Aquifer characteristics, Model studies, Simulation analysis, Wells, Water supply, Pumping, Groundwater movement, Potentiometric level, Regional Analysis, Geohydrology, Water management, *Florida, Floridan aquifer, Southwest Florida Water Management District.

A computer model was calibrated to approximate predevelopment flow conditions in a multilayered aquifer system in 10,600 square miles in west-central Floria. The lowermost aquifer, called the Floridan aquifer, is confined in most of the study area and consists of carbonate rocks ranging up to 1,300 feet thick. The Floridan aquifer is the chief source for large withdrawals and natural springflow in the study area. Daily springflows within the study area have averaged about 2.4 billion gallons. The secondary artesian and the surficial aquifers are much less permeable than the Floridan aquifer. Where they are present and have heads higher than those in the Floridan aquifer, they provide recharge to the Floridan. Initial estimates of recharge to the Floridan aquifer were from water-balance calculations for surface-water basins; initial estimates of transmissivity were from aquifer tests and flow-net analyses. The model was calibrated for the predevelopment era, wherein steady-state flow conditions were assumed. Calibrated transmissivities for the Floridan aquifer range from less than 15,000 to several million feet squared per day. Recharge to the system was about 3,700 cubic feet per second. About 90% was discharged as springflow, and 10% was upward leakage. (USGS)
W83-02113

APPRAISAL OF GROUND-WATER QUALITY NEAR WASTEWATER-TREATMENT FACILITIES, GLACIER NATIONAL PARK, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02115

NITRATE-NITROGEN CONCENTRATIONS IN GROUND WATER FROM THREE SELECTED AREAS IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-255555, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-11, 1982. 32 p, 3 Fig, 9 Tab, 6 Ref, 3 Append.

Descriptors: *Nitrates, *Groundwater, *Water quality, *Data collections, Geology, Wells, Aquifers, Contamination, Drinking water, Geochemistry, *Kansas.

Nitrate-nitrogen data collected during 1976-79 from 333 wells in Kansas were summerized and statistically analyzed on the basis of area, aquifer, and well depth. Nitrate-nitrogen concentrations exceeding the 10 milligrams per liter mixmum allowable concentration in public-water supplies were observed in 4% of the wells analyzed in western Kansas, 16% in central Kansas, and 29% in eastern Kansas. Concentrations exceeding 10 milligrams per liter generally occurred in wells less than 100-feet deep. Data indicate that nitrate-nitrogen concentrations in ground water greater than 10 milligrams per liter generally are derived from nitrogen sources at or near the land surface, although some soluble nitrogen may be derived from fine-grained sediments in some aquifers. Water from shales in central and eastern Kansas and limestones in eastern Kansas exhibited highest median concentrations and the highest incidence of concentrations greater than 10 milligrams per liter. Water from 10% of the wells in unconsolidated Quaternary deposits in western Kansas and almost 30% of the wells in eastern Kansas had nitrate-nitrogen concentrations that exceeded 10 milligrams per liter. Shallow wells in shales, limestones, and uncolsolidated Quaternary deposits are highly susceptible to nitrate contamination. Wells in unconsolidated Tertiary deposits produced water with a low incidence of concentrations greater than 10 milligrams per liter, indicating minimal contamination from sources at or near the land surface. Water from sandstone in all areas had the lowest median nitrate-nitrogen concentrations and the lowest incidence of concentrations greater than 10 milligrams per liter. (USGS)
W83-02116

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1982,
Geological Survey, Salt Lake City, UT. Water Resources Div.
W. F. Holmes.
Utah Division of Water Resources Cooperative Investigations Report 22, 1982. 85 p, 43 Fig, 3 Tab, 4 Ref.

Descriptors: *Groundwater, *Aquifers, *Withdrawal, *Water-level fluctuations, Water quality, Wells, Water use, Water supply, Irrigation, Geohydrology, Water table, Potentiometric level, Groundwater recharge, Hydrologic data, Precipitation, Surface-groundwater relations, Hydrographs, Maps, *Utah.

This is the nineteenth in a series of annual reports that describe ground-water conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1981 was about 832,000 acre-feet, which was about 78,000 acre-feet more than in 1980 and 19,000 acre-feet more than the average annual withdrawal during 1971-80. The increase in withdrawal was due primarily to increases in withdrawal for irrigation. Total withdrawal for irrigation in 1981 was about 548,000 acre-feet, which is 54,000 acre-feet more than reported for 1980. Withdrawal for industry in 1981 was 85,000 acre-feet, which is 20,000 acre-feet more than reported in 1980. Withdrawal for public supply was 141,000 acre-feet, about the same as reported in 1980. Withdrawal for domestic and stock use in 1981 was 60,000 acre-feet, also about the same as reported in 1980. The below average streamflow in most parts of the State during 1981 resulted in below average recharge to the ground-water reservoirs. This, coupled with the increase in withdrawals for irrigation, resulted in declines in ground-water levels in most parts of the State from spring of 1981 to spring of 1982. The Sevier Desert, where surface-water supplies from reservoirs were about average and ground-water withdrawals below average, was the only area in the state where water levels generally rose. (USGS)
W83-02118

RECHARGE IN SEMIARID MOUNTAIN ENVIRONMENTS,
New Mexico Inst. of Mining and Technology, Socorro.
G. W. Gross.

Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173286, Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 153, Las Cruces, June 1982. 36 p, 8 Fig, 23 Ref. OWRT B-059-NMEX(3), 14-34-0001 9123.

Descriptors: *Groundwater, *Recharge, Springflow, *Tritium, *Oxygen 18, *Deuterium, *Computer models, Precipitation, *Artesian aquifer, *New Mexico, *Isotype studies, Isotope hydrology, Groundwater/surface water interaction, Roswell artesian basin.

A systematic investigation of tritium activity in precipitation, surface water, springs, and ground water of the Roswell artesian basin in New Mexico, has been supplemented by hydrogeologic reconnaissance of spring systems; by various statistical correlations and spectral analysis of stream flow and water level records of observation wells; by spring discharge measurements; by stable isotope determinations (oxygen 18 and deuterium); and by numerical modeling of part of the basin. Two recharge contributions to the Principal or Carbonate Aquifer have been distinguished principally on the basis of their tritium label and aquifer response characteristics. A 'fast' recharge component, of relatively high tritium activity, consists of snowmelt and storm runoff and enters the ground water system mostly as leakage from surface drainages where these cross the karstic San Andres Formation. A 'slow' recharge component, low in tritium, is transmitted from the western mountains through formations underlying the San Andres. Near the western basin edge, this 'slow' component, in the form of springs and shallow ground water, also feeds effluent streams which, in turn, lose most of it to the San Andres aquifer where they cross karstic zones. Almost all basin waters (including deep ground water) fall close to the meteoric line of hydrogen/oxygen isotope composition, and this rules out a juvenile origin or appreciable bedrock interaction.
W83-02137

THE CARBONATE AQUIFER OF THE CENTRAL ROSWELL BASIN: RECHARGE ESTIMATION BY NUMERICAL MODELING,
New Mexico Inst. of Mining and Technology, Socorro.
K. R. Rehfeldt, and G. W. Gross.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173294, Price codes: A07 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 142, Las Cruces, February 1982. 136 p, 35 Fig, 18 Tab, 56 Ref, 1 Append. OWRT B-059-NMEX(1), 14-34-0001-9123.

Descriptors: *Groundwater flow, *Recharge models, Transmisivity, Mass balance, *New Mexico, *Groundwater recharge, Model studies, Simulation analysis, Computer models, *Aquifers, *Spatial distribution, Roswell Artesian Basin, Glorieta Sandstone, Yeso Formation, *Carbonate aquifers, Precipitation patterns.

The flow of ground water in the Roswell, New Mexico, Artesian Basin, has been studied since the early 1900s and varied ideas have been proposed to explain different aspects of the ground water flow system. The purpose of the present study was to delineate the spatial distribution and source, or sources, of recharge to the carbonate aquifer of the central Roswell Basin. A computer model was used to simulate ground water flow in the carbonate aquifer beneath and west of Roswell and in the Glorieta Sandstone and Yeso Formation west of the carbonate aquifer. The resulting spatial distribution of recharge strongly indicates that a major component of recharge to the carbonate aquifer is derived from the upward leakage of water from the underlying formation. The model results agree with tritium analyses which indicate that much of the water in the carbonate aquifer is relatively old. Principal conclusions include: 1. The percentage of precipitation that becomes recharge is about 7%. 2. The Yeso and Glorieta contribute much more water to the carbonate aquifer than previously reported. 3. Groundwater conditions along the east slope of the Sacramento Mountains have an impact on ground water conditions in the Roswell Basin.
W83-02138

A BASELINE STUDY OF OXYGEN 18 AND DEUTERIUM IN THE ROSWELL, NEW MEXICO, GROUNDWATER BASIN,
New Mexico Inst. of Mining and Technology, Socorro.
W. G. Gross, and R. N. Hoy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173302, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Report No 144, Las Cruces, May 1982. 95 p, 11 Fig, 7 Tab, 31 Ref. 1 Append. OWRT B-059-NMEX(2), 14-34-0001-9123.

Descriptors: *Oxygen 18, *Deuterium, Recharge, *Artesian aquifers, Groundwater, Computer models, *New Mexico, *Isotope studies, Circulation patterns, *Precipitation patterns, High-mountain runoff, Roswell Artesian Basin.

The isotopic ratios of deuterium and oxygen 18 were measured in precipitation, surface, and ground water samples from the Roswell Artesian ground water basin in south-central New Mexico. The purpose was to determine recharge and circulation patterns. With minor exceptions, samples measured for this study conform to the meteroic water line. No exchange reactions with aquifer rock seem to have taken place. While the D vs. 180 values of precipitation are spread over the whole usual range of the meteroic water line, well and spring samples lie within a relatively narrow range. The narrow range of D and 180 indicates mixing effects which are ascribed to one or more of the following factors: long ground water flow paths; large temperature fluctuations affecting which overwhelm the influence of elevation on precipitation; two sources of atmospheric moisture; interaquifer leakage; and recharge from intermittent streams with the flow-length expanding and contracting over large distances. Ground waters in the southern part of the Basin seem to be on the average, heavier in oxygen 18 as compared to those from the northern part. This may effect a larger contribution of high-mountain runoff in the north. It is concluded that a more precise definition of circulation patterns on the basis of stable isotope differences will require a much greater sampling frequency in both space and time.
W83-02139

FACTORS INVOLVED IN EVALUATING GROUND WATER IMPACTS OF DEEP COAL MINE DRAINAGE,
Geraghty and Miller, Inc., Champaign, IL.
For primary bibliographic entry see Field 4C.
W83-02149

BAYESIAN ANALYSIS OF UNDERGROUND FLOODING,
Mining Development Inst., Budapest (Hungary).
I. Bogardi, L. Duckstein, and F. Szidarovszky.
Water Resources Research, Vol 18, No 4, p 1110-1116, August, 1982. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Flooding, *Groundwater, *Bayesian analysis, Mathematical models, Model studies, *Hungary, Algorithms, Mathematical studies, Aquifers, Tunnels, Construction, Karst, Karst hydrology, Hydrodynamics, Transdanubian region.

The spatial phenomenon of karstic flow into an underground space by means of a Bayesian stochastic model is described. Water inrush into underground works located under a karstic aquifer was studied. The random variables of the model are inrush yield per event, distance between events, number of events per unit underground space, maximum yield, and total yield over mine lifetime. Physically based hypotheses on the types of distributions are made and reinforced by observations. High parameter uncertainty stems from the random characteristic of karstic limestone and the limited amount of observation data. Thus during the design state, only indirect data such as regional information and geolgical analogies are available. Updating of this information should then be done as the construction progresses and inrush events are observed and recorded. A Bayes simulation algorithm is developed and applied to estimate the probability distributions of inrush event characteristics used in the design of water control facilities in underground mining. A real-life example in the Transdanubian region of Hungary is used to illustrate the methodology. (Baker-FRC)
W83-02158

HYDROLOGIC CHARACTERISTICS OF LIMESTONE IN NORTHERN PUERTO RICO IN RELATION TO DEPOSITIONAL ENVIRONMENTS AND DIAGENESIS,
Puerto Rico Univ., Mayaguez. Dept. of Geology.
G. A. Seiglie, and M. T. Moussa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175257, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute, Completion Report, Puerto Rico Univ., Mayaquez, 1983. 98 p, 36 Fg, 50 Ref, 1 Append. OWRT A-044-PR(1), 14-34-0001-1141.

Descriptors: Hydrologic properties, *Limestones, *Diagenesis, Deposition, *Rock properties, Karst, Sedimentary rocks, *Puerto Rico, Tertiary limestone belt, *Oligocene rock, *Pliocene rock, Limestone formations.

The purpose of this work was to describe the stratigraphy and depositional environments of the Tertiary limestone belt, northwestern Puerto Rico and to determine their lineaments and sinkholes. The petrography, macrofossils and foraminifers of the Tertiary limestone formations were studied to determine the lithostratigraphic successions, biostratigraphy and the ancient environments. The lithology, the macrofossils and specially the foraminifers were used to study the depositional paleovironments of the northwestern Puerto Rico formations. The San Sebastian Formation was studied mainly with washed samples of soft rocks while the other formations were studied by means of thin sections of limestone. The distribution of foraminifers in relation to the ancient environments of northern Puerto Rico between these periods is described in detail. (Munoz-Puerto Rico)
W83-02180

INCORPORATION OF PRIOR INFORMATION ON PARAMETERS INTO NONLINEAR REGRESSION GROUNDWATER FLOW MODELS, I. THEORY,
Geological Survey, Denver, CO.
R. L. Cooley.
Water Resources Research, Vol 18, No 4, p 965-976, August, 1982. 13 Ref.

Descriptors: *Groundwater flow, *Nonlinear regression analysis, *Model studies, Prior information, Data collections, Permeability coefficient, *Regression analysis, Groundwater.

A method is presented to analyze cases where prior groundwater flow information of unknown reliability is available. The method is based on the assumption that the prior information is fixed, or invarient, for any particular analysis. This assumption allows an extension of the theory of ridge regression to be used to analyze the method theoretically. Two scales of prior information can be available. First, prior information having known reliability, that is, bias and random error structure, or second, prior information consisting of best available estimates of unknown reliability. A regression method that incorporates the second scale of prior information assumes the prior information to be fixed for any particular analysis to produce improved, although biased, parameter estimates. Approximate optimization of two auxiliary parameters of the formation is used to help minimize the bias, which is almost always much smaller than that resulting from standard ridge regression. It is shown that if both scales of prior information are available, then a combined regression analysis may be made. (Baker-FRC)
W83-02263

STOCHASTIC ANALYSIS OF SPATIAL VARIABILITY IN TWO-DIMENSIONAL STEADY GROUNDWATER FLOW ASSUMING STATIONARY AND NONSTATIONARY HEADS,
New Mexico Inst. of Mining and Technology, Socorro.
S. A. Mizell, A. L. Gutjahr, and L. W. Gelhar.
Water Resources Research, Vol 18, No 4, p 1053-1067, August, 1982. 7 Fig, 1 Tab, 29 Ref.

Descriptors: *Stochastic process, *Groundwater flow, Groundwater, Flow, Spatial distribution, Steady flow, Stationary process, *Monte Carlo Method, Mathematical studies, Simulation analysis.

Two-dimensional steady groundwater flow in a confined aquifer with spatially variable transmissivity T is analyzed stochastically using spectral analysis and the theory of intrinsic random functions. Conditions that ensure a stationary head process are derived, and using two convenient forms for the covariance function of the ln T process, the head covariance function is studied. In addition, the head variogram is obtained for a particular nonstationary case, and the asymptotic head variogram is derived under very general conditions. Results are compared to those from other studies for one- and two-dimensional phreatic flow and others for one- and three-dimensional confined flow. Multidimensional flow analysis results in a significantly reduced head variance. The head correlation remains high over much greater distances than in the ln T correlations. The variogram for nonstationary heads continues to grow logarithmically as lag distance increases, independent of the form of the input covariance in the nonstationary case. The conditions for stationarity are contrasted with the corresponding results obtained for the one- and three-dimensional cases of other researchers. The head variance calculated from the stationary theory agrees with that of previous Monte Carlo simulations. (Author's abstract)
W83-02264

TRAVELING WAVE SOLUTIONS OF SATURATED-UNSATURATED FLOW THROUGH POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Water Resources Research, Vol 16, No 1, p 117-122, February, 1980. 9 Ref.

Descriptors: *Porous media, *Groundwater movement, *Wave propagation, Saturated flow, Unsaturated flow, Water table.

Traveling wave solutions to the problem of saturated-unsaturated flow of water through a uniform porous medium are derived, and the regularity properties of the solutions are studied. It is assumed that the medium obeys Darcy's law for saturated flow and the extended Darcy's law for unsaturated flow. Singularity occurs in the higher-order derivatives of flux with respect to the space coordinate in the solutions at water tables. The water tables in the solutions can be interpreted as acceleration waves of the nth order where n is a positive integer in cases where gravity is present or absent. (Cassar-FRC)
W83-02266

DIFFUSIVITY, STORATIVITY, AND THE DUPUIT ASSUMPTIONS FOR PERIODIC FLOW IN A VERTICAL HELE-SHAW MODEL,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
J. A. Williams.
Water Resources Research, Vol 18, No 4, p 925-930, August, 1982. 6 Fig, 6 Ref.

Descriptors: *Flow, *Groundwater, *Mathematical equations, *Storativity, *Hele-Shaw model, Model studies, Groundwater waves, *Diffusivity.

The linear theory of shallow phreatic aquifers and the role of storativity are investigated by using data from a periodic flow in a vertical Hele-Shaw model. The results of the study indicate that the theory is valid for specific values of the length of the periodic fluctuation in the phreatic surface, the amplitude of the fluctuation applied at the boundary, and the average depth. These values are not necessarily the upper limits. It was also demonstrated that the storativity varies with depth and frequency and assumes a maximum value at the depth for which the dominant meniscus configuration produces a minimum specific retention. Additionally, analyses of amplitudes indicate that local variations in the storativity (some of the order of 50%) occur systematically without any significant effect on the theoretically predicted amplitude behavior. Consequently, the linear theory requirement of a constant diffusivity may be relaxed. (Baker-FRC)
W83-02268

A NOTE ON THE MEANING OF STORAGE COEFFICIENT,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan, and B. Y. Kanehiro.
Water Resources Research, Vol 16, No 2, p 423-429, April, 1980. 1 Tab, 14 Ref.

Descriptors: *Storage coefficent, *Porous media, *Groundwater movement, Drainage, Pore pressure, Fluid flow, Hydrology.

The term storage coefficient and the related expressions, storativity, specific storage, and total compressibility, are frequently used in hydrogeology, petroleum engineering, and other fields. These parameters seek to express the quantity of water required to be added to or removed from storage in order to change (under conditions of drainage) the average hydraulic head or pore pressure of a porous material by a given amount. Originally introduced over 4 decades ago, the storage parameter is still used by many in the restricted sense of a coefficient occurring in the partial differential equation describing fully saturated flow. However, with significant increase in our computational abilities using powerful numerical integration techniques, there presently exists a need to have a more fundamental appreciation of the storage parameter as it relates to transient fluid flow in porous media. Such a fundamental approach requires consideration of the type of loading to which the porous medium is subject as well as certain conventions followed by various workers in actually defining the parameter. While no new derivations or results are presented, attempts are made to assemble in a single place the various ideas relevant to the storage parameter in order to obtain a generalized perspective. (Author abstract)
W83-02269

A STATISTICAL APPROACH TO THE INVERSE PROBLEM OF AQUIFER HYDROLOGY 3. IMPROVED SOLUTION METHOD AND ADDED PERSPECTIVE,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Water Resources Research, Vol 16, No 2, p 331-346, April, 1980. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Aquifer characteristics, *Transimissivity, *Groundwater movement, Hydrologic models, Finite element method, Model studies, Statistical analysis.

Previous related papers presented a new statistically based approach to the problem of estimating spatially varying aquifer transmissivities on the basis of steady water level and flux data and illustrated the application of this method. The purpose of the present paper is to introduce a new efficient method of solution which works under a much wider range of conditions than the method previously employed. The new method is based on a variational theory developed by Chavent (1971), which is extended here to the case of generalized nonlinear least squares. The method is implemented numerically by a finite element scheme. The inverse problem is posed in terms of log transmissivities instead of transmissivities and is solved by a Fletcher-Reeves conjugate gradient algorithm in conjunction with Newton's method for determing the step size to be taken at each iteration. The new method has several advantages over the traditional approach: savings in computer storage and time, guarantee that computed transmissivities are always positive, and ability to disregard small errors in the model and in the flow rate and sink/source data. Two theoretical examples are included to demonstrate the ability of the new method to deal with artificial noise of a relatively large amplitude, derived from a given stochastic model. The results demonstrate that the inverse method may be capable of computing log transmissivity estimates with an error variance which is significantly smaller than that of the original log transmissivity data. Undercalibration and/or overcalibration may produce relatively poor results. (Cassar-FRC)
W83-02277

ANALYSIS OF FLOW THROUGH HETEROGENEOUS RANDOM AQUIFERS. 2. UNSTEADY FLOW IN CONFINED FORMATIONS,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, p 1571-1585, October, 1982. 2 Fig, 17 Ref.

Descriptors: *Flow, *Aquifers, Unsteady flow, Confined aquifers, Isotropy, Conductivity, Transmissivity, Porosity, Groundwater flow, Groundwater, Hydrologic equation, Physical properties.

In this study on the direct problem of water flow through a heterogeneous formation of random stationary and isotropic structure the case of unsteady flow was studied in particular. Two typical problems were considered: first the transient case in which the head is initially constant and subsequently starts to change, and second, the periodic case in which the average head gradient varies harmonically with time for an extended period. The main result of the study was the determination of the criteria which enable one to apply the simpler and well-developed steady state analysis to time dependent flows. It is emphasized that these criteria have been derived for unconditional probability distributions of the conductivity and storativity. The main effect of conditioning is in principle to relax these criteria and to render the steady state analysis applicable in a wide variety of situations. (Baker-FRC)
W83-02330

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES 2. THE SOLUTE TRANSPORT,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, No 4, p 835-848, August, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Groundwater flow, *Solute transport, *Stochastic hydrology, *Conditional probability, Anisotropy, Porous media, Transmissivity, Hydraulic conductivity, Analysis of variance, Fate of pollutants, Model studies, Aquifer characteristics, Chemical properties.

Solute transport in a heterogeneous formation subject to uncertainty in transmissivity and hydraulic conductivity was studied using a stochastic model. The approximate closed form solutions were derived for a solute pulse in an average uniform flow through a formation of unconditional stationary random transmissivity. The solute concentration in this case had a high degree of uncertainty, which was much less in cases where the solute input volume was large compared with the heterogeneity integral scale. The concentration expectation did not obey a diffusion type equation in the case of two-dimensional flows unless the solute body had traveled a distance larger than a few tens of the transmissivity integral scales. The distance was exceedingly large for many applications. Conditioning of transmissivity or hydraulic conductivity reduced variance, but only when measurements at a dense set of points were available. The traditional approach of predicting solute concentration by solving deterministic partial differential equations is highly questionable in the case of heterogeneous formations. (Cassar-FRC)
W83-02338

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES 1. CONDITIONAL SIMULATION AND THE DIRECT PROBLEM,
Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 18, No 4, p 813-833, August, 1982. 3 Fig, 26 Ref.

Descriptors: *Stochastic hydrology, *Groundwater movement, *Steady flow, *Conditional probability, Flow, Recharge, Wells, Aquifer characteristics, Analysis of variance, Model studies, Porous media, Hydraulic conductivity, Transmissivity, Anisotropy.

Groundwater flow in heterogeneous porous formations of large extent is modeled using a stochastic process. The formation properties (hydraulic conductivity and transmissivity) and the flow variables (head, specific discharge, solute concentration) are treated as spatial random variables subjected to uncertainty, rather than deterministic variables. The main purpose of the study is to analyze the influence of conditional probability of input variables on the statistical structure of the dependent variables. The unconditional probability density functions are assumed to be stationary-multivariate-normal, while conditioning accounts for the measured values at a few points in the formation. Two problems of groundwater flow are discussed: conditional simulation and the direct problem for steady flow. Perturbation approximations were used to obtain analytical results. In conditional modeling the measured values at a few points in the aquifer are kept fixed, and uncertainty prevails at all other points. Then statistical computations are performed for the subensemble of aquifers which preserve the measured values. As a result both input and output variables are nonstationary. Conditioning reduces the variance of the variables. (Cassar-FRC)
W83-02339

ADAPTIVE EXPLICIT-IMPLICIT QUASI THREE-DIMENSIONAL FINITE ELEMENT MODEL OF FLOW AND SUBSIDENCE IN MULTIAQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, C. Preller, and T. N. Narasimhan.
Water Resources Research, Vol 18, No 5, p 1551-1561, October, 1982. 6 Fig, 1 Tab, 29 Ref.

Descriptors: *Flow, *Model studies, *Aquifers, Aquifer characteristics, Groundwater flow, Groundwater, Permeability, Subsidence, California.

A quasi three-dimensional finite element model is presented for the analysis of groundwater flow and land subsidence due to pumpage in multiaquifer systems. In the model, aquifers are simulated with the aid of two-dimensional horizontal finite element grids. Each aquifer is connected to its neighbors above and below by one-dimensional vertical finite element strings which allow leakage to take place across aquitards and aquicludes. Land subsidence is modeled by varying the void ratio of each vertical element according to nonlinear version of Terzaphi's one-dimensional consolidation theory. A major feature of the new method is its ability to solve the finite element equations explicitly in one part of the mesh and implicitly in another part, depending on the ratio between the stability limit of each node and any given time step size. Since the hyraulic diffusivity of aquitards is usually very small compared to that of aquifers, it is often possible to solve the finite element equations explicitly for most, and sometimes all, aquitard nodes, This leads to a virtual decoupling of the aquifer equations during a given time step, which results in a significant saving of computer time and storage. (Baker-FRC)
W83-02352

ELECTRICAL RESISTIVITY-HYDRAULIC CONDUCTIVITY RELATIONSHIPS IN GLACIAL OUTWASH AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish.
Water Resources Research, Vol 17, No 5, p 1401-1408, October, 1981. 6 Fig, 4 Tab, 34 Ref.

Descriptors: *Model studies, *Glacial aquifers, *Electrical studies, Geophysics, *Soil water, *Permeability coefficient, *Soil porosity, *Particle size, Aquifers, Sand aquifers, Groundwater potential, Pore size, Theoretical analysis, Interstitial water, *Rhode Island.

A three-phase parallel resistor model is proposed as a sound theoretical basis for relating apparent aquifer formation factors to pertinent hydrogeophysical parameters in homogeneous isotropic sand. The model explicitly includes parameters of pore water resistivity, grain size and shape, porosity, tortuosity, and intergranular surface conductance, and is supported by data from laboratory tests. The model shows that intergranular surface conductance is an important factor at small grain sizes and high pore water resistivities, serving to lower the apparent formation factor. The model also demonstrates that direct relationships between hydraulic conductivity and formation factors are weak in the normal range of pore water resistivity, showing a strong dependence on porosity. A simulated field curve relating the apparent formation factor to hydraulic conductivity compared favorably with the comparable curve from field data for 13 pumping test sites in southern Rhode Island when systematic variation of in situ porosity and aquifer layering effects were taken into account. Both theorectical and empirical results demonstrate a positive correlation between aquifer apparent formation factor and hydraulic conductivity; however, quantitative interpretation is imprecise due to nonuniqueness and inherent variation in important aquifer parameters, especially porosity. (Geiger-FRC)
W83-02354

BIBLIOGRAPHY ON GROUND-WATER RECHARGE IN ARID AND SEMIARID AREAS,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 10C.
W83-02362

INFILTRATIN AND GROUNDWATER RECHARGE. TRITIUM: A DIRECT PROBE,
North Dakota State Univ., Fargo. Dept. of Chemistry.
R. D. Koob.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182097, Price codes: A05 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion Report, March 1981. 78 p, 18 Fig, 8 Tab, 31 Ref, 1 Append. OWRT A-060-NDAK(1), 14-34-0001-9036.

Descriptors: *Groundwater recharge, *Recharge, *Water balance, *North Dakota, *Infiltration, Evaporation, Transpiration, Runoff, Soil moisture, Water table, *Tritium, Mining, Falkirk mining site.

The objective was to evalute the groundwater recharge rate on the Falkirk mining site in western North Dakota. Thornthwaite's water balance method was used. This method uses mean monthly temperatures to estimate potential evapotranspiration. In the original work, comparison of potential evapotranspiration with precipitation was used to classify different regions by climatic conditions. In 1948, Thornthwaite and Mather modified the method for application to problems such as surface runoff prediction and groundwater recharge rate evaluation. Although Thronthwaite's method does not include humidity, radiation or wind, it was judged to provide sufficiently accurate estimates of evapotranspiration to allow calculation of groundwater recharge rates given precipitation and runoff data. This judgment was made by comparing Thornwaite's method with the more comprehensive treatments of Jensen and Haise and the modified Penman method. All methods showed potential evapotranspiration to be greater than mean monthly precipitation during the summer months. This study showed that application of Thornthwaite's method predicted that no recharge occured during the period over which data were available. Physical measurements of soil moisture to depths below the root zone through the same period, however, indicate that recharge did occur. That recharge does occur is further substantiated by the failure of continuous use of the groundwater for domestic supplies to deplete the water table. The Thornthwaite method appears to be an adequate model.
W83-02367

MECHANISMS, DISTRIBUTION AND FREQUENCY OF GROUNDWATER RECHARGE IN AN UPLAND AREA OF WESTERN NORTH DAKOTA,
North Dakota Geological Survey, Grand Forks.
B. W. Rehm, G. H. Groenewold, and W. M. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182121, Price codes: A05 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Report of Investigation No 75, ND State Univ., Fargo, September 1982. 72 p, 18 Fig, 6 Tab, 36 Ref, 1 Append. A-061-NDAK(1), 14-34-0001-9036.

Descriptors: *Groundwater, *Groundwater recharge, *Piezometers, *Stable isotopes, *North Dakota, Soil water movement, Infiltration rate, Evapotranspiration, Surface-Groundwater relationships, Hydrogeology, Aquifer, Hydraulic conductivity, Soil moisture, Falkirk, Water wells.

Groundwater recharge mechanisms have been examined at a specific site in Western North Dakota. Estimates of groundwater recharge presented here are based on a network of piezometers and water-table wells within the study area near Falkirk, N.D. These data were supplemented with observations on evapotranspiration rates, soil moisture content changes, and stable isotope concentrations. Groundwater recharge takes place throughout the landscape at widely varying rates. The average areal groundwater recharge rate through the 150 km super 2 study area is on the order of 0.12 m super 3.yr super -1.m super -2 to 0.025 m super 3.yr super -1.m super -2. These recharge rates are for 1979 only. The spring of 1979 was the wettest spring of the decade of the 1970s, so the recharge rates are probably greater than the long-term, average groundwater recharge rate. The 1979 Falkirk groundwater recharge rates generally fall on the high end of the range of recharge values that have previously been reported from the Northern Great Plains. Stable isotope data indicate that much of the water at or above the water table during the spring resembles snowmelt or slough waters. The spatial distribution of recharge is largely dependent upon two factors--the size of surface depressions and underlying lithology.
W83-02370

PORE PRESSURES IN DEBRIS FAILURE INITIATION,
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2G.
W83-02371

USE OF PROTOTYPE MODELING FOR ESTIMATING NATURAL GROUNDWATER RESOURCES,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
V. M. Shestopalov, and V. L. Boyarko.
Water Resources (English Translation), Vol 8, No 6, p 619-628, November/December, 1981. 3 Fig, 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 6, p 97-109, November-December, 1981.

Descriptors: *Groundwater management, *Estimating, Similarity analysis, Mathematical equations, Water balance, Water supply, Water resources development, *USSR, Slopes, Podolian Upland.

The problems of estimating groundwater resources of a territory from the standpoint of the similarity

theory were investigated. The main characteristics of the method are the use of computer inspection of mathematical models of different complexity for the purpose of establishing the optimal structure of the model and the use of 'external' criteria for the quality of the structures being inspected. The study indicated that the dimensionless equation permitted making an interpolation prediction of the distribution of the runoff characteristics of the selected water-balance plots. An increase in the number of significant dimensionless numbers will make it possible to reduce the error of determining the values of the groundwater runoff being predicted. Thus the use of the similarity theory when estimating groundwater resources allows a more concrete and objective consideration of the available information on direct and indirect factors influencing their formation, which leads to an increase in the reliability of the results of investigations. The method is useful for predicting natural groundwater resources of large regions and individual areas or small basins promising for the practical use of groundwaters. (Baker-FRC)
W83-02418

TRITIUM IN GROUNDWATERS OF THE CENTRAL SECTION OF THE BAIKAL-AMUR MAIN LINE ROUTE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 5B.
W83-02443

AN ELECTRIC MICROINTEGRATOR FOR SOLVING ONE-DIMENSIONAL UNSTEADY GROUNDWATER FLOW PROBLEMS,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
M. O. Chaban.
Water Resources (English Translation), Vol 8, No 6, p 643-646, November/December, 1981. 1 Fig, 3 Ref. Translated from Vodnye Resursy, No 6, p 129-133, November/December, 1981.

Descriptors: *Groundwater movement, *Model studies, Infiltration, Leakage, Surface flow, Percolation, Groundwater mining, Water supply, Construction, Microintegrator, Measuring instruments, Mathematical equations.

An electric microintegrator combines such important properties as simplicity and accessibility for a wide range of specialists with the possibility of solving the majority of problems encountered in practical calculations of groundwater dynamics in multilayered beds with an inhomogeneous distribution of percolation properties, including consideration of leakage and infiltration for confined and free-surface flow in steady and unsteady regimes. The one-dimensional electric microintegrator is small and consists of five main units: the model of the bed, the unit of limiting conditions, the control unit, the measuring device, and the power unit. The initial data for modeling depends on its purpose. Calculation of the model begins with determination of the similarity scales. Modeling occurs practically instantaneously. The mathematical substantiation of one-dimensional electrical unsteady-flow modeling of percolation processes and the given methodological materials permit developing a new type of instrument. The simplicity of use and simultaneously the wide range of problems solvable in hydrogeologic calculations permit the wide introduction of microintegrators in practical calculations during surveying, designing, and operating water management objects in water supply, reclamation, construction, and mining. (Baker-FRC)
W83-02444

2G. Water In Soils

PASSIVE MICROWAVE SENSING OF SOIL MOISTURE UNDER VEGETATION CANOPIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W83-02146

EFFECT OF THE METHOD FOR DETERMINING PORE SIZE DISTRIBUTION ON PREDICTION OF THE HYDRAULIC CONDUCTIVITY FUNCTION AND OF INFILTRATION,
Louvain Univ. (Belgium).
R. Ragab, J. Feyen, and D. Hillel.
Soil Science, Vol 134, No 2, p 141-145, August, 1982. 5 Fig, 12 Ref.

Descriptors: *Permeability coefficient, Soil properties, Mathematical equations, *Infiltration, Percolation, Hydrualic permeability, Permeability, Hydraulic profiles, *Pore size, *Hydraulic conductivity, *Mercury intrusion method.

Water desorption and mercury intrusion methods were used to characterize the pore size distribution of a sand, and the hydraulic conductivity-water content function was calculated. When used as input to an infiltration simulation model the hydraulic conductivity water content function obtained from the water desorption method resulted in a better prediction of actual wetting profiles than did the function from mercury intrusion. However, the results of the latter method could be made to match those of the former by use of an empirical correction factor. It appears, therefore, that the mercury intrusion method, which offers the advantage of speed, can be helpful in characterizing soil hydraulic behavior only if its results are appropriately adjusted. (Baker-FRC)
W83-02192

FINITE-DIFFERENCE SOLUTIONS OF THE INFILTRATION EQUATION,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
R. J. Kunze, and D. R. Nielsen.
Soil Science, Vol 134, No 2, p 81-88, August, 1982. 8 Fig, 2 Tab, 12 Ref.

Descriptors: Mathematical equations, *Infiltration, Soil water, *Vertical distribution, Rainfall infiltration, Groundwater movement, Leaching, Percolation, Seepage, Richards' equation, *Finite difference interative method.

An accurate, two-term solution of Richards' equation for one-dimensional vertical infiltration was obtained by a finite difference, iterative method (FINDIT). Wetting distances and soil water content distributions closely resemble those obtained by Philip with his series solution, which is extremely accurate at short times but fails to converge for long times. Solutions appear to be equally accurate for all times using the proposed procedure. Hence, the proposed procedure does not require additional approximations or matching factors to link separate analyses for short or long infiltration times. Because the solution equation consists of only two terms, the inflow is logically partitioned into matric and gravitational components. The matric component is expressed in a constant sorptivity term S, conceptually identical to the sorptivity S of Philip. The gravitational component is time-dependent and increases to a maximum value equal to the hydraulic conductivity at the soil surface as time approaches infinity. After appropriate coefficients have been determined, both matric and gravitational components of cumulative infiltration may be expressed independently by a logarithmic relationship that avoids the use of D and K functions and iterative computer procedures. (Baker-FRC)
W83-02193

REDOX POTENTIAL, OXYGEN DIFFUSION RATE, AND SOIL GAS COMPOSITION IN RELATION TO WATER TABLE LEVEL IN TWO SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
F. Callebaut, D. Gabriels, W. Minjauw, and M. De Boodt.
Soil Science, Vol 134, No 3, p 149-156, September, 1982. 9 Fig, 23 Ref.

Descriptors: *Water table level, Soil properties, *Oxygen depletion, *Oxidation-reduction potential , Acidity, *Soil gases, *Oxygen diffusion rates, Groundwater, Water supply, Crop yield, Aeration, Thermal properties.

Changes in several soil aeration indices (redox potential, soil gas composition, and oxygen diffusion rate) were measured as caused by different stagnating groundwater levels. The oxygen diffusion rate was related to the soil water pressure head, so that the aeration status of a soil profile could be determined from simple tensiometer readings. Under steady-state moisture conditions a decrease in oxygen content was reflected by an increase in carbon dioxide content. The redox potential was related to the soil pH. The oxygen diffusion rate increased when the water table was lowered. Only at water table depths of more than 50 cm did the oxygen diffusion rate at the 5-cm soil depth exceed the level at which aeration is considered sufficient to sustain vigorous root growth. Empirical relations are presented for calculating the aeration profile in soils from water pressure head measurements with tensiometers. Redox potential measurements did not reflect the soil aeration status in oxygen-rich environments. (Baker-FRC)
W83-02194

SIMULTANEOUS APPROXIMATION OF WATER CAPACITY AND SOIL HYDRAULIC CONDUCTIVITY BY PARAMETER IDENTIFICATION,
Colorado State Univ., Fort Collins. Dept. of Mathematics.
D. W. Zachmann, P. C. Du Chateau, and A. Kute.
Soil Science, Vol 134, No 3, p 157-163, September, 1982. 2 Fig, 3 Tab, 4 Ref.

Descriptors: Soil properties, Model studies, *Permeability coefficient, *Soil water, Mathematical studies, Mathematical models, *Water capacity, Soil characteristics, Unsaturated flow, Hyudraulic properties, Fluid mechanics, *Hydraulic conductivity.

Methods are sought by which the functions of water capacity and hydraulic conductivity can be simultaneously determined under a variety of flow situations by casting the problems as identification problems. Attention was directed toward formulating the problem so as to minimize the experimental effort needed to collect the data from which the solution is to be determined. Initially the method is appled to a relatively uncomplicated flow system, a homogeneous, one-dimensional, vertical column of soil that is allowed to drain under gravity from saturation. Initial and boundary conditions are prescribed on the system, sufficient to ensure that the governing flow equation will have a unique solution, and then cumulative discharge data is used to simultaneously determine the water capacity and hydraulic conductivity functions. Results of some numerical examples are presented. The distinctive feature of this study is that techniques of parameter identification are used to simultaneously determine both the water capacity and hydraulic conductivity functions of a soil. (Baker-FRC)
W83-02196

DISTRIBUTION OF PHOSPHORUS IN COLUMNS OF VERY SANDY SOILS AFTER LEACHING WITH WATER OR DIAMMONIUM PHOSPHATE SOLUTIONS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
R. C. Sorenson, and R. A. Wiese.
Soil Science, Vol 134, No 2, p 97-104, August, 1982. 3 Fig, 6 Tab, 18 Ref.

Descriptors: *Phosphorus, *Leaching, *Soils, Soil types, Sand, Infiltration, Percolation, Fertilizers, Agricultural chemicals, Potassium, Diammonium phosphate, Nebraska.

Columns of three sandy soils were leached with water after surface applications of diammonium phosphate (DAP) or with solutions containing DAP. Final concentrations of Bray and Kurtz extractable P and, for two soils, exchangeable K were measured. Substantial amounts of P and K were leached downward. Where large amounts of water were applied and DAP was added in dry form, some native P was removed from all soils. For the most part, the P distribution patterns were similar for the three soils, but the magnitude of effects of P and water (solution) rate varied. Gen-

erally, the amount of P extracted was linearly related to the amount of applied P, whereas it was curvilinearly related to the amount of applied water. Large amounts of K were leached through columns of one soil. The amount of extractable K remaining in the column was linearly related to P applied and logarithmically related to the amount of water (solution) applied. (Baker-FRC)
W83-02199

EFFECT OF THE ENERGY OF RAIN ON ITS INFILTRATION INTO SOIL,
Mowcow Inst. of Land-Management Engineers (USSR).
N. I. Il'in, A. M. Abramov, and A. G. Morin.
Water Resources (English Translation), Vol 8, No 6, p 652-654, November/December, 1981. 1 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No 6, p 141-144, November/December,1981.

Descriptors: *Rainfall intensity, *Infiltration, *Soil moisture, Rainfall-runoff relationships, Energy, Rainfall infiltration, Rainfall penetration, Moisture gradient, Soil types.

The rate and duration of infiltration of precipitation into soil depend primarily on the hydrophysical properties of the soil and characteristics of the falling precipitation. An experimental study was made of the dependence of infiltration of water into various soil types on the structure of rain and its energy characteristics. The concept of structure of rain includes its intensity and the average size of drops. It is obvious that the decrease of the infiltration capacity under the effect of the energy of rain will be different for different soils and different states of cultivation. The proposed energy approach can be used in geological and ameliorative calculations of the start of overland runoff in the case of natural and artificial rain. (Baker-FRC)
W83-02249

APPLICATION OF RECENT RESULTS IN FUNCTIONAL ANALYSIS TO THE PROBLEM OF WETTING FRONTS,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Water Resources Research, Vol 16, No 2, p 314-318, April, 1980. 16 Ref.

Descriptors: *Infiltration, *Soil water, *Wetting, Soil physics, Porous media.

Evidence is presented to support the view that wetting fronts in porous media with a finite propagation speed are generally singular surfaces. The term, singular surface, implies that some of the physical variables are discontinuous on this surface. Recent results in nonlinear functional analysis are cited as evidence. Although conclusions reached in this paper do not totally invalidate the traditional viewpoint (that wetting fronts in porous media described by Darcy's law are not singular surfaces), it is important to note that no strict mathematical proof of classical general solutions for this situation has yet been advanced. The viewpoint presented in this paper has been supported by mathematical proof in several concrete examples. (Cassar-FRC)
W83-02267

USE OF ATMOSPHERIC FLUOROCARBONS F-11 AND F-12 TO DETERMINE THE DIFFUSION PARAMETERS OF THE UNSATURATED ZONE IN THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W83-02289

HYDRODYNAMIC DISPERSION DURING ABSORPTION IN A FINE SAND 2. THE CONSTANT FLUX CASE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
Water Resources Research, Vol 18, No 5, p 1435-1443, October, 1982. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Dispersion coefficient, *Absorption, *Soil water, Sand, Hydrodynamics, Porous media.

Earlier work on hydrodynamic dispersion during absorption in fine sand under constant concentration conditions indicated that the dispersion coefficient was velocity dependent. The more exacting constant flux case using influent boundary fluxes of water from 3.28 times 10 to the minus 7th power to 1.05 times 10 to the minus 5th power was analyzed in this study. These values allowed the ratio of mechanical dispersion component of the dispersion coefficient to the molecular diffusion component to vary from 0.43 to 5.81. Computer-derived numerical solution results were within the scatter of experimental data, suggesting that the hydrodynamic dispersion coefficient is velocity dependent. A beta value (dispersion length) of 0.0001 m was used for this soil. (Cassar-FRC)
W83-02329

MACROPORES AND WATER FLOW IN SOILS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven, and P. Germann.
Water Resources Research, Vol 18, No 5, p 1311-1325, October, 1982. 8 Fig, 3 Tab, 143 Ref.

Descriptors: *Macropores, *Water flow, *Infiltration, *Soil porosity, Reviews, Subsurface flow, Darcys law, Fate of pollutants, Porosity, Channeling, Capillary water, Piping, Cracks, Unsaturated flow, Saturated flow, Model studies, Flow rates, Flow velocity, *Reviews, Nonuniform flow, Vertical flow, Pore size, Pore water, Soil saturation, Soil structure, Soil water.

A literature review for macropores in soils concerns their occurence and their role in infiltration and subsurface storm flow. Macropores are important considerations in studying water flow through unsaturated soil. They are channels for rapid movement of solutes and pollutants through soils. Macropores have been defined by various authors as having capillary potentials greater than -0.1 to greater than -10.0 kPa or equivalent diameters of 730 to 10,000 microns. In this paper macropores are defined as structures, regardless of size, that permit channeling. Macropores may be formed by soil fauna, plant roots, cracks and fissures from shrinkage and weathering, and natural piping. Factors affecting macroporosity are weather (drought, freezing, intense rainfall, and flora and fauna alterations), long-term ecological changes (conditions affecting populations of mice and worms), and land use (plowing, compaction by grazing animals). Macropores may be formed within 1 or 2 years and may persist up to hundreds of years. Experimental and theoretical studies on the effects of macropores on infiltration and subsurface flow are discussed. After the initial stage, infiltration is not adequately described by approaches based on Darcy's law. Although macropores may make up a small portion of total soil voids, they may dominate vertical flow rates under some conditions. However, air entrapment in macropores may reduce infiltration. Two domain models (macropore and matrix) are available to describe infiltration, but they must be regarded as no more than exploratory. It is likely that a variable zone of saturation at the base of the soil profile will dominate lateral macropore flows through unsaturated soil in generating subsurface storm flows. In the saturated zone fast response depends on steep slopes and high hydraulic conductivity caused by macropopes. Where a high degree of connectivity between macropores exists, channeling can be considerable. Current models of subsurface flows involving macropores are highly speculative. A future task is to integrate the concepts of flow in capillary pores and macropores into one coherent flow theory. (Cassar-FRC)
W83-02345

ELECTRICAL RESISTIVITY-HYDRAULIC CONDUCTIVITY RELATIONSHIPS IN GLACIAL OUTWASH AQUIFERS,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W83-02354

PORE PRESSURES IN DEBRIS FAILURE INITIATION,
Washington Univ., Seattle. Dept. of Geological Sciences.
N. F. Humphrey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182139, Price codes: A09 in paper copy, A01 in microfiche. Washington Water Research Center Publication No 45, Washington State Univ., Pullman, September 1982. 169 p, 45 Fig, 3 Tab, 52 Ref, 3 Append. OWRT A-108-WASH(1). 14-31-0001-1277.

Descriptors: *Bedrock depressions, *Soil wedge, *Pore-water flow, Pressure, Groundwater, Flow, Convergence, Water table, Saturated-unsaturated groundwater flow, *Pacific Northwest, *Finite element analysis.

Soil filled bedrock depressions, or soil wedges, with typical dimensions of less than 10 x 10 x 2 meters, have been identified as major initiation locations for debris of failures in the Pacific Northwest. The ultimate stability of a soil wedge is determined by the pore-water pressures generated during rain storms by the convergence of shallow ground-water flow into the bedrock depressions. Analysis of the flow convergence is complicated by two factors, which are that the convergence is intrinsically three-dimensional which dictates a numerical approach to the analysis, and that the flow into a depression does not constitute an isolated system, but is only a small element of the overall hill-slope hydrology. The complex geometry of the soil wedges necessitates the use of the finite-element technique in construction of the numerical simulation model of the pore-water flow. However, the finite-element method is constrained by the physical size of a non-linear problem and it is not at present possible to model an entire hillslope flow system in three dimensions and time. To simulate a section of a hillslope with the finite element model it is necessary to nest the three-dimensional model of the wedge region within a two dimensional model of the overall hillslope groundwater flow. This is achieved with an approximate analytical technique that is developed for the calculation of the transient water-table positions within a hillslope under storm conditions. The development of the analytic technique rests on the linearization of the flow equation and the application of linear systems theory for the subsequent solution. The approximation technique has restricted this study to steep hillslopes with shallow soils that overlie relatively low hydraulic conductivity substrates. Two-dimensional finite-element modeling was employed to check the accuracy of the approximation technique. The results of the flow modeling lead to generalizations about saturated-unsaturated groundwater-flow in hillslopes with shallow soils that are subjected to storms. The pore-pressure fields are used to estimate the factor of safety for a particular wedge failure, thus demonstrating a methodology that allows analysis of the stability of wedge locations under destabilizing factors such as heavy rainfall or loss of root strength due to logging.
W83-02371

TRAFFICABILITY FACTOR IN A SILTY CLAY LOAM SOIL,
Maine Univ. at Orono. Dept. of Agricultural Engineering.
J. Bornstein, and W. E. Hedstrom.
Transactions of the ASAE, Vol 25, No 5, p 1240-1244, September/October, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Soil types, *Trafficability, *Drainage, Subsurface drainage, Seasonal variations, Crop yield, Loam.

Subsurface drainage systems affect spring and fall trafficability, the timeliness of planting and subsequent crop harvest and yield on a silty clay loam marine soil. Drainage effectiveness and trafficability response were evaluated by mercury tensiometers for soil moisture, a cone penetrometer for soil strength, and a subjective walk-on trafficability index. Soil moisture and penetrometer resistance measurements were taken over the shallow drains spaces at 3, 6, and 12m, at the mid-point between

drains and at two comparable random locations in undrained plots. Trafficability developed more rapidly in the spring on a slowly permeable representative silty clay loam soil with drainage than on undrained plots. A good correlation was noted between soil moisture tension and soil strength in the 0-15 cm soil depth, which could be matched to soil readiness and thus to workday or trafficable conditions. Corn yields vs drainage for 1980, a year characterized by a dry spring, showed no significant difference between drainage and no drainage. Alfalfa in 1981, when drained plots were ready for cultivation 3 wk earlier than undrained plots, gave yields significantly greater for the drained over the no drainage treatment from two cuttngs. There was no difference between drained treatments. (Baker-FRC)
W83-02421

MODELING SOIL MOISTURE AND EFFECTS OF BASIN TILLAGE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02422

INVESTIGATION OF THE EFFECT OF PHYSICOCHEMICAL CONDITIONS AND TEMPERATURES ON THE INITIAL GRADIENT AND REGIME OF FLOW IN CLAYS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. M. Gol'dberg, and N. P. Skvortsov.
Water Resources (English Translation), Vol 8, No 6, p 629-637, November/December, 1981. 4 Fig, 1 Tab, 20 Ref. Translated from Vodnye Resursy, No 6, p 110-119, November/December, 1981.

Descriptors: *Clays, *Subsurface flow, *Permeability, Soil water, Flow rates, Flow patterns, Flow measurement, Flow characteristics, Physicochemical properties, Temperature effect, Infiltration, Fluid mechanics, Hydrogeology.

Certain properties of the fluid enclosed in the pores of clays are cited in a brief review of the process of flow in clays and the mechanism of variability of their percolation properties under various physicochemical and thermodynamic conditions. A majority of published works supports the phenomenon of violation of Darcy's linear law in the region of small hydraulic gradients in the presence of clays. However, these works do not give an unequivocal answer to the question of the presence of an initial flow gradient in clays. The results of experimental investigations on the initial flow gradient suggest that during flow of a fluid in clays a linear flow law and independence of the permeability coefficient from the value of the gradient are noted in the region of large hydraulic gradients. The change from linear to nonlinear flow is manifested in a rather marked decrease of the rate of flow and permeability coefficient, which is not proportional to the rate of decrease of the hydraulic gradient. The value of the initial hydraulic gradient for the same clay is greater for fresh water and less for a chloride solution. The adsorption complex affects the value of the initial gradient. The temperature has an especially strong effect on the initial gradient. As temperature increases, the initial hydraulic gradient decreases, and at sufficiently high temperatures it apparently may not be manifested at all. These results permit the assumption that under deep aquifer conditions, clay strata can be permeable, under the effect of increased temperatures and highly mineralized chloride solutions which in turn can cause a more intense vertical migration of subsurface waters. (Baker-FRC)
W83-02448

2H. Lakes

PHYCOLOGICAL STUDIES IN LAKES ONTARIO, ERIE, HURON, AND SUPERIOR,
Canada Centre for Inland Waters, Burlington (Ontario).
M. Munawar, and I. F. Munawar.
Canadian Journal of Botany, Vol 60, No 9, p 1837-1858, 1982. 15 Fig, 9 Tab, 33 Ref.

Descriptors: *Phytoplankton, *Trophic level, *Species composition, Lakes, Great Lakes, *Lake Ontario, *Lake Erie, *Lake Huron, Lake Superior, Limnology, Biomass, Eutrophic lakes, Oligotrophic lakes, Species distribution, Seasonal variation, Chlorophyll a, Primary productivity, Productivity, Algae, Diatoms, Baseline studies, Lake classification, Lake basins.

Phytoplankton species compositions were studied for 12 years using standard indentification, enumeration, and data-handling techniques to provide a baseline for evaluating long-term trends. This paper is an overview of voluminous data on the phytoplankton assemblage. For each lake the following information is included: water quality parameters, mean distribution of phytoplankton biomass, total chlorophyll a, primary production, and species composition, as well as seasonal variations of the activity coefficient and the previously mentioned parameters in distinct regions of the lakes. Biomass and species composition reflected the current trophic status of the lakes. Biomass values (g per cu m) were: Erie, 5.3 in the western basin, 3.2 in the central basin, and 2.4 in the eastern basin; Ontario, 3.3 inshore and 2.6 offshore; Huron, 0.8; and Superior, 0.1. Seasonal peaks were observed in Erie and Ontario but not in Huron and Superior. Diatoms were the main group in all lakes except offshore Ontario, where green algae dominated. Lakes were tentatively classified: Superior, ultraoligitrophic; Huron, oligotrophic; Ontario, Mesoeutrophic; and Erie, eastern and central basins, mesoeutrophic, and western basin, eutrophic. (Cassar-FRC)
W83-02102

MAT-WATER PHOSPHORUS EXCHANGE IN AN ACID BOG LAKE,
Michigan Univ., Ann Arbor. School of Natural Resources.
F. F. Hooper, and L. S. Morris.
Ecology, Vol 63, No 5, p 1411-1421, 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Chemical composition, *Phosphorus, Groundwater movement, Nutrients, Cycling nutrients, Chemical reactions, Evapotranspiration, Bogs, Sphagnum, Air pollution, *Bog mat, *Michigan, North Gate Lake.

By means of a series of mat-labeling experiments using P-32 and through the analysis of water budgets of the lake and mat, the exchange of phosphorus between a bog lake and its surrounding Sphagnum mat and the fate of mat phosphorus entering the limnetic zone of the lake were examined. Movement of phosphorus in the system was regulated to a large degree by decomposition profiles, water balance, and water density. Decomposition regimes and water density regulated the depth of movement, but water balance dynamics regulated time of phosphorus movement and the distance it moved to and from the open water. Loss of water during high evapotranspiration concentrated the soluble unreactive phosphorus (SUP) within the mat, but at the same time created a flow of lake water low in phosphorus into the mat. At increasing distances from the lake, dilution of SUP by lake water became progressively less, and there appeared to be some upward flow of the phosphorus-rich water from deeper strata of the mat. Thus a gradient in phosphorus concentration was established within the mat adjacent to the lake by evapotranspiration. Modification of the littoral zone brought about by the development of a Sphagnum mat not only strongly modified phosphorus flow patterns, but also created phosphorus storage and high concentrations of phosphorus at a variety of sites within the lake basin and mat. Compared to nonbog lakes, bog lake systems exhibit greatly reduced recycling of phosphorus because of reduced biological transformations and storage, which reduces physical recycle. (Baker-FRC)
W83-02106

A FAUNAL AND SEASONAL STUDY OF THE AQUATIC INSECTS IN TWO WATER ECOSYSTEMS IN SOUTH ARKANSAS - DEGRAY RESERVOIR AND THE UPPER CADDO RIVER,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6G.
W83-02127

CHLOROPHYLL, PHOSPHORUS, SECCHI DISK, AND TROPHIC STATE,
Environmental Monitoring Systems Lab., Las Vegas, NV.
V. W. Lambou, S. C. Hern, W. D. Taylor, and L. R. Williams.
Water Resources Bulletin, Vol 18, No 5, p 807-813, October, 1982. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Lake classification, *Eutrophication, *Trophic level, *Chlorophyll a, *Phosphorus, *Secchi disks, Nutrients, Water quality, Color, Light attenuation.

The relationships between chlorophyll a, total phosphorus, Secchi disk depth, and trophic state were studied using data on 757 U.S. lakes collected during the EPA's National Eutrophication Survey (NES). Application of Carlson's equation relating summer Secchi disk depth to chlorophyll a to the 757 lakes resulted in a correlation coefficient of 0.56. This suggested that light attenuation due to non-chlrophyll suspensoids or dissolved color was more important in controlling the amount of chlorophyll a produced per unit of total P in the NES lakes than in Carlson's set of 147 lakes (correlation coefficient, 0.93). Forty-four lakes, chosen to represent a full range of water clarity, were ranked using 18 different trophic state measurements and single to multivariate indices and compared with rankings obtained from mean summer ambient total P and chlorophyll a. The trophic state measurements and indices were much more successful in ranking the lakes against total P than chlorophyll a. This indicated that many lakes have differences in trophic rankings depending on whether the ranking mechanism is based on primary nutrients or biological manifestations. Assuming that total P or Secchi disk depth and chlorophyll a have a constant relationship in all lakes can lead to false conclusions about trophic state and unnecessary mangement controls. In this study Secchi disk depth ranked the test set of lakes against total P as well as or better than many other, more complex methods based on chlorophyll a concentrations. (Cassar-FRC)
W83-02155

THE ROLE OF GIZZARD SHAD (DOROSOMA CEPEDIANUM) IN EUTROPHIC FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman, and H. M. Kennedy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175299, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 64, Univ. of Florida, Gainesville, 1982. 83 p, 21 Fig, 9 Tab, 104 Ref, 2 Append. OWRT A-041-FLA(1), 14-34-0001-0110 14-34-0001-1110.

Descriptors: Limnology ecology, Ecosystems, Fish, *Eutrophication, Aquatic productivity, Warm-water fish, Algal blooms, Food chains, *Florida, *Shad, Eutrophic lakes, Lake Eustis, Orthophosphates, Phytoplankton, Cyanophyta, Chlorophyta, Diatoms.

The function of gizzard shad (Dorosoma cepedianum) in Florida lakes was investigated through: 1) short-term stocking experiments, 2) in situ algal viability studies, and 3) a simulation model of fish, plankton, and nutrient interactions. Fish were stocked at natural and elevated densities in enclosures filled with lake water. Phosphorus forms, chlorophyll a, algal productivity, and phytoplankton and zooplankton composition and abundance were monitored for eight and seven days, respectively. Shad had no impact on chlorphyll, productivity, or algal abundance in either experiment. In the natural density experiment, a significant increase was noted for orthophosphate and its ratio to total phosphorus, while copepod abundance de-

creased significantly. No significant differences were noted in the elevated density experiments. Incubation of fish feces indicated that several species of blue-green algae remain viable after passage through the shad's gut. A simulation model indicated that the shad population of hypereutrophic Lake Eustis is a steady state and that present shad removal practices will have little impact on either fish or plankton communities. Our data suggest that shad promote eutrophication both through elevation of orthophosphate concentrations and differential digestion of diatoms and green algae. This fish is not a suitable biocontrol agent for phytoplankton in eutrophic subtropical lakes.
W83-02184

PRIMARY PRODUCTION IN THE BRATSK RESERVOIR AND FACTORS DETERMINING IT,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
O. M. Kozhova, and V. N. Pautova.
Water Resources (English Translation), Vol 9, No 1, p 82-92, January/February, 1982. 4 Fig, 2 Tab, 46 Ref. Translated from Vodnye Resursy No 1, p 128-138, January/February, 1982.

Descriptors: *Reservoirs, *Primary productivity, Productivity, Biomass, Aquatic life, Seasonal variation, Aquatic productivity, *Organic matter, Bratsk Reservoir, *USSR, Water pollution effects, Seston.

Special studies were made of primary production of organic matter in the region of the Balagan wide-water expanse at the facilities of the biological station of the Biological Research Institute, Irkutsk State University. The processes of primary production of organic matter were studied on the basis of long-term regime observations covering all seasons, including investigations of the hydrochemical, thermal, and light regimes and recording of the successions of phytoplankton communities, their biomass and content of the main pigments in seston. (Baker-FRC)
W83-02243

RELATIONSHIP OF WATER-EXCHANGE INDICES OF VALLEY RESERVOIRS,
Moscow State Univ. (USSR).
K. K. Edel'shtein.
Water Resources (English Translation), Vol 8, No 6, p 603-607, November/December, 1981. 1 Fig, 15 Ref. Translated From Vodnye Resursy, No 6, p 70-74, November-December, 1981.

Descriptors: *Reservoirs, *Water exchange, *Mathematical equations, Indices, Mozhaisk Reservoir, *USSR.

The most widespread indices of the average rate of internal water exchange in valley reservoirs are the relationships between the inflow of water into the reservoir or outflow from it and the volume of water present in it. These indices of the average rate of internal water exchange are based on the hypothesis of a cross-sectionally uniform displacement of water present in the reservoir before the start of the calculated period by the water that newly entered it from inflows. To find a method of calculating the average rate of water exchange capable of taking into account the entire diversity of the factors and processes controlling it, an attempt was made at statistical processing of the data of actual observations of the water and hydrochemical regimes of a typical valley reservoir. The Mozhaisk reservoir was selected as morphologically simple and elucidated by detailed and reliable morphometric, water balance, and hydrological and hydrochemical data. The variability over a territory of the average depth of lakes and reservoirs and average annual depth of runoff from the drainage basin of flowing water bodies indicates the predominance of the effect of azonal geomorphological factors on the rate of water exchange in reservoirs, especially in the phase of equilibrium of their water balance, which usually coincides with the low water period of the rivers feeding them. (Baker-FRC)
W83-02244

FLUCTUATIONS OF WATER LEVEL IN A CLOSED LAKE AND THEIR OPTIMAL PROBABILISTIC PREDICTION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. E. Prival'skii.
Water Resources (English Translation), Vol 8, No 5, p 571-584, November/December, 1981. 3 Fig, 3 Tab, 28 Ref, Translated from Vodnye Resursy, No 5, p 5-21, November/December, 1981.

Descriptors: Water levels, *Lakes, *Statistical methods, Mathematical studies, Estimating, Predicting, *Probabilistic process, *Water level fluctuations, Fluctuations.

A statistical description of the fluctuations of the water level of a closed lake in the case of a steady inflow regime is given and the problem of prediction for the steady and unsteady cases is examined. In the steady regime one can obtain the solution in an explicit form for all most important characteristics of the level such as variance, correlation function, spectrum, and prediction error. (Baker-FRC)
W83-02245

SEASONAL ASPECTS OF THE SURFACE AND ADVECTIVE HEAT FLUXES OF KOOTENAY LAKE, BRITISH COLUMBIA,
National Water Research Inst., Vancouver (British Columbia).
R. C. Wiegand, E. C. Carmack, R. J. Daley, C. B. J. Gray, and S. Jasper.
Water Resources Research, Vol. 18, No 5, p 1493-1502, October, 1982. 12 Fig, 26 Ref.

Descriptors: *Seasonal variations, *Lakes, *Heat flow, Hydrologic budget, Heat budget, Heat balance, Physical properties, *British Columbia, Kootenay Lake, Temperature effects, Rivers, *Advection, Wind.

A description is given of the heat and water balances of Kootenay Lake, British Columbia. While the lake has a moderately high throughflow, the heat budget is more in character with a lake that is little influenced by rivers. The role of the rivers is highlighted in the thermal history of lakes. A contrast is drawn between Kootenay Lake and Kamloops Lake, British Columbia; the latter is a strongly riverine lake with a much greater heat budget. It is suggested that the riverine nature of lakes can be characterized using a renewal time that applies to that region of the lake lying above the base of the river plume. Further, the relative roles of advective and surface effects can be qualitatively described using a ratio of surface buoyance of wind energy to river production of turbulent energy. These parameterizations may prove to be useful descriptors in a lake classification system based upon riverine quality. (Baker-FRC)
W83-02331

LAKE BOTTOM DYNAMICS AND MORPHOMETRY: THE DYNAMIC RATIO,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
For primary bibliographic entry see Field 2J.
W83-02332

USE OF THE ISOTOPIC COMPOSITION OF NATURAL WATERS OF WESTERN TURKMEN SSR FOR DETERMINING THEIR ORIGIN,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2K.
W83-02441

TEMPERATURE STRUCTURE AND STATIC STABILITY OF BOTTOM WATERS OF LAKE BAIKAL,
Institut Zemnoi Kory, Irkutsk (USSR).
V. A. Golubev.
Water Resources (English Translation), Vol 8, No 6, p 607-619, November/December, 1981. 5 Fig, 30 Ref. Translated from Vodnye Resursy, No 6, p 75-89, November/December, 1981.

Descriptors: *Temperature effects, *Bottom water, *Lake Baikal, *USSR, *Stability analysis, Lakes, Deep water, Vertical distribution, Stratification, Distribution, Temperature gradient.

Factors influencing the vertical stability of deep and bottom waters of lakes are investigated. The vertical temperature gradients of bottom waters in the southern and middle Lake Baikal depression are close to zero or negative. The stability of bottom waters with such a temperature structure is very sensitive to nontemperature factors. Mineralization is the most important of them. To maintain static stability of the bottom waters in the indicated regions of the lake it is necessary that their mineralization not decrease with depth. A superadiabatic bottom increase of temperature is noted in the deepwater zone of northern Baikal. The geothermal data indicate a hydrothermal nature of this phenomenon. An analysis of the equation of state for the specific volume of water with consideration of an increase in density of waters during mixing indicates the possibility of accumulation of the discharging hydrothermal solutions in the bottom zone of the lake. The excess mineralization of the hydrothermal solutions relative to the Baikal waters apparently provided for static stability of the bottom waters in the depression. In a number of cases positive temperature gradients close in value to the geothermal were recorded in the thin bottom boundary layer of water in various regions. These may be due to conductive transfer of the earth's internal heat by water masses of Baikal. (Baker-FRC)
W83-02445

2I. Water In Plants

SOIL- AND ATMOSPHERE-INDUCED PLANT WATER STRESS IN COTTON AS INFERRED FROM FOLIAGE TEMPERATURES,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, R. J. Reginato, and S. M. Farah.
Water Resources Research, Vol 18, No 4, p 1143-1148, August, 1982. 6 Fig, 14 Ref.

Descriptors: *Water stress, *Plant water potential, Infrared thermometry, *Cotton, Temperature effects, Soil moisture, Moisture availability, Water potentials, Transpiration.

Foliage temperatures were obtained on cotton by means of infrared thermometry. These temperatures, along with air wet and dry bulb temperature measurements, were used to study certain relationships existing between the water contents of soil and air and the abilty of the crop to maintain transpiration at the potential rate. It was found that as soil water content was progressively depleted following an irrigation, departure from potential transpiration began to occur at smaller and smaller values of air vapor pressure deficit in a regularly predictable fashion. It was also noted that the plant water potential of cotton transpiring at the potential rate is a function of the air vapor pressure deficit and that the difference between this base value and the tension that develops under nonpotential conditions is a unique function of a newly developed plant water stress index. Finally, an example of the application of this foliage temperature based index to evaluating the effects of an irrigation event is presented. (Baker-FRC)
W83-02159

SOIL-VEGETATION-HYDROLOGY STUDIES, VOLUME II, A USER MANUAL FOR ERHYM: THE EKLAKA RANGELAND HYDROLOGY AND YIELD AND MODEL,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2A.
W83-02314

SOIL-VEGETATION-HYDROLOGY STUDIES. VOLUME I. RESEARCH RESULTS, SUMMARY, DISCUSSION, AND RECOMMENDATIONS,
Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.

For primary bibliographic entry see Field 3F.
W83-02315

CONSUMPTIVE WATER USE RESPONSE OF MAIZE TO CHANGES IN ENVIRONMENT AND MANAGEMENT PRACTICES: SENSITIVITY ANALYSIS OF A MODEL,
California Univ., Los Angeles.
W. H. Terjung, J. T. Hayes, P. A. O'Rourke, J. E. Burt, and P. E. Todhunter.
Water Resources Research, Vol 18, No 5, p 1539-1550, October, 1982. 12 Fig, 4 Tab, 14 Ref.

Descriptors: *Evapotranspiration, *Model studies, *Soil-water-plant relationships, *Seasonal variations, Temperature effects, Soil types, Consumptive use, Wind, *Corn, Irrigation practices, Humidity, Water consumption, Crop yield, Groundwater.

WATER, a parametric crop water use model, employs climatic data to calculate water consumption for a variety of crops, using a modification of the Penman equation which included specific crop and growth stage effects. The response of WATER was demonstrated for a grain corn crop to changes in a variety of important environmental and decision-making inputs: air temperature, solar radiation, relative humidity, irrigation frequency, and amount of irrigation water applied. Five temperature, five solar radiation, and six relative humidity regimes were examined for an entire growing season. Also, five different water application schemes and four irrigation frequencies were included in the study. It was noted that evapotranspiration increased on the average by about 2.5% per degree increase in air temperature. One % change in solar radiation resulted in a 1.5% change in evapotranspiration, while a similar change in relative humidity caused a 0.4% response in evapotranspiration. Contrasting soil types, in addition to affecting irrigation frequency, were able to change the responding evapotranspiration by over 10%. (Baker-FRC)
W83-02340

EVALUATING A PORTABLE INSTRUMENT FOR DETECTING DROUGHT AND SALINITY STRESSES IN PLANTS THROUGH CHANGES IN LEAF OPTICAL PROPERTIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W83-02363

INCREASING RETURNS FROM WATER AND NITROGEN APPLIED TO IRRIGATED LANDS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 3F.
W83-02406

2J. Erosion and Sedimentation

MANGANESE FLUXES FROM MISSISSIPPI DELTA SEDIMENTS,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 2L.
W83-02109

THE ROLE OF LAKE AND RESERVOIR SEDIMENTS AS SINKS IN THE PERTURBED GLOBAL CARBON CYCLE,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W83-02206

CALCULATION OF THE DEPOSITION OF RIVER SEDIMENTS ON THE NEARSHORE ZONE AND EVALUATION OF THE STABILITY OF THE SUBMARINE FAN,
Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
V. V. Sakvarelidze, and S. S. Pirumov.
Water Resources (English Translation), Vol 9, No 1, p 76-82, January/February, 1982. 11 Ref. Translated from Vodnye Resursy, No 1, p 120-127, January/February, 1982.

Descriptors: *Sediments, *Rivers, *Sediment transport, Deltas, River sediments, Sedimentation, Currents, Waves, Fans.

A quantitative study was made of the processes of deposition of river sediments on the nearshore zone and formation of the depositional body. The problems of the deposition of river sediments on the nearshore zone were considered using the following two hypotheses when calculating the range of deposition of sediments: the sediments begin to be deposited from that site where the standard deviations of the vertical velocity fluctuation are less than the settling velocity of the sediments, and the longitudinal velocities of the water and sediment particles coincide. It was shown that the first hypothesis was valid only in those cases when the spreading jet did not lose contact with the bottom. In cases of spreading jet with detachment from the shore slope, particularly in the presence of a halocline, all beach-forming sediments regardless of the degree of turbulence of the spreading jet were deposited starting from the site of detachment. The second hypothesis was acceptable for all fine sediments with a diameter less than 4 mm. It was concluded that it is possible and expedient to reduce the volume of river sediments being transported to great depths of the nearshore zone by using a previously proposed sediment-retaining structure. This structure is intended for those rivers at the mouth of which there is no pronounced bar, or the bar is so thin that it is eroded by the current in an average flood and the river jet transports a large part of the sediments to the stepoff or to the canyon. (Baker-FRC)
W83-02251

ON WHY GRAVEL BED STREAMS ARE PAVED,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, and P. C. Klingeman.
Water Resources Research, Vol 18, No 5, p 1409-1423, October, 1982. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Sediment transport, *Gravel, *Streambeds, Bed load, Particle size, Grain size, Sand, Pavement, *Oregon, Oak Creek, Model studies.

The hypothesis is presented that pavement in poorly sorted gravel bed streams is a regulator that enables a stream to transport the coarse half and fine half of the bed load at equal rates, that is, pavement forms so that all available grain sizes are of nearly equal mobility. This involves exposing proportionately more coarse grains to the flow, since they are less mobile than fine particles. Field data from Oak Creek, Oregon, are used to quantify the concept and to develop river pavement grain size distributions. Size distributions of bed load and bed material are similar. The model predicts that sand bed streams should not have pavement, in agreement with observations. (Cassar-FRC)
W83-02272

UNSTEADY OVERLAND SEDIMENTATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II.
Journal of Hydrology, Vol 56, No 3-4, p 325-346, April, 1982. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Sediment transport, *Fluid mechanics, *Hydrologic models, *Mathematical studies, *Sedimentation, *Rills, Rill erosion, Model studies, Hydrodynamics, Flow pattern, Overland flow, Mathematical models, Hydrographs, Channels.

Sediment flux to fluid flow in a rill may be physically modeled for simultaneous sediment entrainment, deposition and lateral inflow. Unsteady flow and sedimentation in overland rills are then described by continuity equations and approximations for flow, entrainment and transport capacity. The equations are reduced to one-dimensional equations of motion without sheet flow approximations. The method-of-characteristics solution to these equations for uniform excess rainfall yields the hydrograph and a three-part sediment concentration graph. The resulting model allows substitution of reasonable parameter values. When the flow is steady-uniform over infinite channel length or when the steady-uniform transport capacity concentration in the rill is equal to the lateral inflow concentration, sediment concentration is given by steady-uniform transport capacity equations. Boundary conditions on the first derivative of sediment concentration with time suggest constraints on the form of the equations for fluid flow, entrainment, and transport capacity which agree well with empirical results. Some general observations on the solution are made which describe the expected pattern of overland sedimentation. (Geiger-FRC)
W83-02283

THE USE OF REMOTE SENSING TECHNIQUES AND THE UNIVERSAL SOIL LOSS EQUATION TO DETERMINE SOIL EROSION,
Idaho Univ., Moscow. Dept. of Forest Resources.
K. M. Schuchard, and L. C. Tennyson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182006, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, January 1983. 25 p, 3 Fig, 22 Ref. OWRT A-080-IDA(1), 14-34-0001-2114.

Descriptors: *Soil erosion, *Remote sensing, *Landsat data, Agriculture, Forest and range lands, VICAR/IBIS image processing, COver type identification, Universal soil loss equation, Annual soil erosion, Annual soil loss tolerance, *Idaho, Hangman Creek.

Satellite data with ancillary watershed information was used to determine soil erosion of agriculture, forest and range lands in the southern portion of the Hangman Creek watershed, Benewah County, Idaho. Vegetation cover types derived from satellite data and the VICAR/IBIS image processing computer software package were determined with 89% accuracy. The vegetation cover types identified on the study area were dense-mixed forest, medium density mixed forest, ponderosa pine forest, wheat, lentils, barley, bluegrass, pasture and brush. Soil erosion (tons/acre/year) was estimated with the Universal Soil Loss Equation. Annual soil loss in the study area ranged from 0.003 tons/acre/year in the dense to mixed-forest cover type to 18.7 tons/acre/year in the wheat and lentil cover types. Annual erosion was compared with the annual soil loss tolerance to determine critical erosion areas.
W83-02326

LAKE BOTTOM DYNAMICS AND MORPHOMETRY: THE DYNAMIC RATIO,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
L. Hakanson.
Water Resources Research, Vol 18, No 5, p 1444-1450, October, 1982. 9 Fig, 5 Tab, 9 Ref.

Descriptors: *Sediment transport, *Bottom sediments, *Lake morphometry, Erosion, Sediment distribution, *Sweden, Lake basins, Lake beds, Lake sediments, Water depth.

This paper, a continuation of previous work, develops an improved formula for describing the relationship between lake bottom dynamics and lake morphometry. The areal distribution of erosion and transportation or accumulation processes at lake bottoms is governed by an energy factor (includes lake area and maximum depth), a slope factor (dependent on mean depth and lake area) and a form factor (dependent on maximum depth and mean depth). The term dynamic ratio equals the square root of lake area divided by mean depth. Application of this formula to empirical data from nine Swedish lakes confirms its improved accuracy. The model is not significantly improved by accounting for shore irregularity and/or lake slope. This model applies only to single basin lakes. In multibasin lakes each basin must be treated separately. The most accurate re-

sults are produced for lakes 1 to 5000 sq km in area. (Cassar-FRC)
W83-02332

MODEL EXPERIMENTS ON MOBILE, PAVED GRAVEL BED STREAMS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, S. Dhamotharan, and H. Stefan.
Water Resources Research, Vol 18, No 5, p 1395-1408, October, 1982. 12 Fig, 8 Tab, 13 Ref.

Descriptors: *Sediment transport, *Gravel, *Streambeds, Bed load, Particle size, Grain size, Pavement, *Oregon, Oak Creek.

The pavement in poorly sorted gravel streams is shown to be a mobile bed phenomenon, according to the results of laboratory flume studies. This type of pavement decreases the difference in mobility between large and small grains by exposing more of the larger grains to the flow. Pavement can coexist with the motion of all available grain sizes because only a small proportion of surface grains are in motion at a given time. Many particles constantly interchange with the pavement. The immediate subpavement particles move occasionally, and deeper particles rarely move. The flume experiments provide accurate quantitative models of field streams, obeying the same bed load laws. Either a sediment feed flume or a recirculating flume is usable for modeling. Natural streams, such as Oak Creek, Oregon, are usually a hybrid of the two types. (Cassar-FRC)
W83-02343

2K. Chemical Processes

BALANCE - A COMPUTER PROGRAM FOR CALCULATING MASS TRANSFER FOR GEOCHEMICAL REACTIONS IN GROUND WATER,
Geological Survey, Reston, VA. Water Resources Div.
D. L. Parkhurst, L. N. Plummer, and D. C. Thorstenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-255902, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-14, 1982. 29 p, 10 Tab, 5 Ref.

Descriptors: *Computer programs, *Mass transfer, *Geochemistry, *Groundwater, Water sampling, Chemical reactions, Minerals, BALANCE, Fortran.

BALANCE is a Fortran computer designed to define and quantify chemical reactions between ground water and minerals. Using (1) the chemical compositions of two waters along a flow path and (2) a set of mineral phases hypothesized to be the reactive constituents in the system, the program calculates the mass transfer (amounts of the phases entering or leaving the aqueous phase) necessary to account for the observed changes in composition between the two waters. Additional constraints can be included in the problem formulation to account for mixing of two end-member waters, redox reactions, and, in a simplified form, isotopic composition. The computer code and a description of the input necessary to run the program are presented. Three examples typical of ground-water systems are described. (USGS)
W83-02114

CAUSES OF ACIDIFICATION OF FOUR STREAMS ON LAUREL HILL IN SOUTHWESTERN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5B.
W83-02136

ISOTOPIC COMPOSITION AND GEOCHEMICAL CHARACTERISTICS OF SUBSURFACE WATERS OF THE KRIVOI ROG BASIN AS INDICATORS OF THEIR INTERRELATION AND ORIGIN,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
I. F. Vovk, and V. I. Vysotskii.
Water Resources, Vol 9, No 1, p 15-21, 1982. 1 Fig, 4 Tab, 15 Ref. Translated from Vodnye Resursy, No 1, p 39-47, January-February, 1982.

Descriptors: *Geochemistry, *Brines, *Subsurface water, Krivoi Rog Basin, *USSR, Groundwater movement, Saline water, Mixing, *Isotope studies, Tectonics, Karst hydrology, Geohydrology.

A combination of traditional hydrogeochemical methods and isotopic methods was effective in determining the interrelation, origin, and exchange of groundwater in the Krivoi Rog iron ore basin in the Ukrainian Shield. The movement of groundwater is difficult to discern in this region because of deep recharge (to 900 m), ancient circulation of subsurface waters, mixing of subsurface waters, of different origin and age, and intense mining. The three vertical hydrochemical zones are: upper, slightly mineralized sulfate waters; middle, sulfate-chloride waters of increased mineralization; and lower, highly mineralized sodium chloride waters. The discharge of highly mineralized waters decreased rapidly after mining started; therefore, they were probably of tectonic and karstic origin. The primary brine with 330 mg per liter of salt originated in the Devonian salt-bearing stratum. Horizontal movement was negligible, and brines penetrated to considerable depths along faults and during tectonic activity. (Cassar-FRC)
W83-02247

PRINCIPLES OF ORGANIC CONTAMINANT BEHAVIOR DURING ARTIFICIAL RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02405

USE OF THE ISOTOPIC COMPOSITION OF NATURAL WATERS OF WESTERN TURKMEN SSR FOR DETERMINING THEIR ORIGIN,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
L. G. Sokolovskii, and M. P. Ezhova.
Water Resources, Vol 9, No 1, p 10-15, January/February, 1982. 4 Tab, 11 Ref. Translated from Vodnye Resursy, No 1, p 33-38, January/February, 1982.

Descriptors: *Isotope studies, *Saline lakes, *Groundwater movement, Brines, Mixing, *USSR, Chemical composition, Salt flats, Subsurface water, Lakes, Geochemistry, Lake Karashor, Uzboi bed, Lake Kurtysh-Baba, Lake Molla-Kara, Kara-Bogaz-Gol Strait, Turmken SSR, Surface-groundwater relations.

Isotopic compositions of surface and subsurface waters were determined in several regions of western Turkmen SSR: the northern salt deposit of the Karashor depression, lakes of the Uzboi bed (Kurtysh and Molla-Kara, which lie in a bed that formerly connected the Aral and Caspian Seas), Kara-Bogaz-Gol strait and gulf, and flowing wells draining water from Jurassic-Neocomian and Upper Cretaceous deposits. The Karashor brines, found everywhere under the seasonally-deposited layer of salt, had low Ca, I, and Li levels and were depleted in radium and enriched in U. Results caused a revision of former estimates of depth of circulation of waters discharging in this area. Both groundwater and precipitation participate in formation of salts. The four-basin, clear Lake Kurtysh-Baba had higher temperatures at depths greater than 1.5 m than at the surface. This was not caused by discharge of thermal waters but by reflection of solar rays from the salt crystal (gypsum) bottom. Mineralization generally increased with depth. Isotopic composition of the groundwater and lake waters showed that lake recharge came from groundwater with low mineral content. The higher mineral levels in the lake bottom were produced by evaporation. Chemical analysis of Lake Molla-Kara and associated subsurface waters showed that both groundwater (Jurassic) and water from deeper horizons, emanating as jets from faults, were feeding the lake. The Kara-Bogaz-Gol Gulf brines were derived from evaporation of Caspian Sea water and from subsurface waters from Cretaceous deposits. (Cassar-FRC)
W83-02441

INVESTIGATION OF THE RELATION BETWEEN THE HYDROCHEMICAL AND HYDROLOGICAL REGIMES OF RIVERS OF THE AMUR BASIN,
G. N. Pogodaev, and G. V. Tsytsarin.
Water Resources, Vol 9, No 1, p 37-44, January/February, 1982. 4 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 74-82, January-February, 1982.

Descriptors: *Runoff, *Geochemistry, *Surface-groundwater relations, Water quality, Amur River, *USSR, Rivers, Ions, Chemical properties, River flow, Flow, Groundwater, Calcium, Bicarbonate, Mathematical equations.

The normal ionic runoff was computed for about 40 rivers in the Amur Basin, USSR, for each month. The index of ionic runoff varied from 6.02 to 63.32 tons per sq km per year. The higher values of 22.21-63.32 tons per sq km per year were found in basins subject to waterlogging. The volume of river discharge dominated the changes and seasonal dynamics of the ionic runoff. Minimum values were noted in February-March. Maximum concentrations of runoff occurred during the period of monsoon rains and snowmelt. The peak of ionic runoff usually coincided with peak discharge. Ionic runoff in downstream reaches was greater than in upper reaches. Groundwater hydraulically connected with the rivers did not contribute minerals to the river during the spring and summer-fall floods. Bicarbonate (0.16-1.97 meq per liter) dominated the anionic component and Ca (0.03-1.33 meq per liter) dominated the cationic component. An equation is given for calculating the chemical composition of water and ionic runoff for rivers. (Cassar-FRC)
W83-02442

2L. Estuaries

MANGANESE FLUXES FROM MISSISSIPPI DELTA SEDIMENTS,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
J. H. Trefry, and B. J. Presley.
Geochimica et Cosmochimica Acta, Vol 46, No 10, p 1715-1726, 1982. 9 Fig, 4 Tab, 45 Ref.

Descriptors: *Minerals, *Flux, *Sediment transport, Sediments, Sedimentation, River sediments, River, Deltas, Mississippi River, *Mississippi River Delta, *Manganese, Gulf of Mexico.

The hypothesis that diffusive manganese fluxes from rapidly accumulating Mississippi Delta sediments provide excess Mn to the deep Gulf of Mexico at the expense of Delta sediments was investigated. It was noted that massive sediment deposition on the Mississippi River Delta established reducing conditions sufficient to bring about Mn dissolution in the top few millimeters of sediment. As a result, significant fluxes of dissolved Mn pass from the Delta sediments to the overlying water column. This process was examined by a study of chemical partitioning of Mn in river particulates and Delta sediments and from interstitial water chemistry. Remobilized Mn is accurately transported away from the Delta area with aluminosilicate detritus, thereby providing the excess Mn to the deep Gulf waters. (Baker-FRC)
W83-02109

RIVERINE TRANSPORT OF NUTRIENTS AND DETRITUS TO THE APALACHICOLA BAY ESTUARY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, and H. C. Mattraw, Jr.
Water Resources Bulletin, Vol 18, No 5, p 849-856, October, 1982. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Nutrients, *Organic matter, *Flooding, Detritus, Organic carbon, Leaves, Litter, Apalachicola River, *Florida, Forest watersheds, Flood plains, Nitrogen, Phosphorus, Wetlands, Estuaries, Rivers, River flow.

Nutrient fluxes from the Apalachicola River basin to Apalachicola Bay, Florida, measured for a year (June 3, 1979, to June 2, 1980) were: total organic carbon, 210,000 metric tons; total nitrogen, 21,000 metric tons: and total phosphorus, 1,700 metric tons. About 15% of the 3100 sq km drainage area consists of bottomland harwood forest, from which nutrients and deritus are periodically removed by floding. Levels of total organic C and total N were 6-9 mg per liter and 0.75-1.0 per liter, respectively, remaining stable under a variety of flow conditions from 500 to 3000 cu m per sec. However, total P tended to increase with flow increases, from 0.02 mg per liter during low flows to 0.10 mg per liter during floods. The March 1980 flood discharge, 4 times that of the main outflow of 800 cu m per sec, carried higher organic loads than summer and fall flows. The 86-day spring flood accounted for 53, 60, 48, and 56% of the annual flux of total organic C, particulate organic C, total N, and total P, respectively. Timing of the floods with respect to leaf litter production was important. In 1980 the flood plain and leaves were first inundated in late winter-early spring. An autumn tropical storm could move large amounts of decomposed leaves to the bay. (Cassar-FRC)
W83-02153

ESTUARINE SEDIMENT CONTROLS ON TRACE METAL DISTRIBUTIONS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02175

THE SEDIMENTARY AND PHYSICAL DYNAMIC PROCESSES OF SELECTED ESTUARIES AND RIVER INLETS OF PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock, K. Grove, and M. L. Hernandez.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175240, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Puerto Rico Univ., Mayaquez, 1983. 68 p, 31 Fig, 6 Tab, 19 Ref. OWRT A-051-PR(1), 14-34-0001-1141.

Descriptors: *Sediment transport, *Estuaries, Rivers, *Deposition(Sediments), Sedimentary rocks, *Puerto Rico, Anasco-Mayaguez shelf, *Sediment distribution, Mud sediments.

Sediment deposition on the Anasco-Mayaguez shelf reflects sea level rise over a subaerially developed surface interacting with carbonate reef and river sediment sources. Wave and current patterns have played a role in distribution of the sediments. As sea level rose, a transgressive sea deposited blanket sands across the erosional surface and filled most of the submerging river channels. Coral reefs formed on local highs and contributed skeletal components to the sediment. Deepening sea level changed the character of the terrigenous deposits and reef sediments. As sea level approached the present level, patterns of modern sediment deposition began. In the modern environment, the dominant facies are the mud and sandy mud sediments from the rivers.
W83-02179

PHOSPHORUS AND ORGANIC CARBON IN THE SEDIMENTS OF A POLLUTED SUBTROPICAL ESTUARY, AND THE INFLUENCE OF COASTAL RECLAMATION,
Fisheries Research Station, Aberdeen (Hong Kong).
For primary bibliographic entry see Field 5B.
W83-02203

CALCULATION OF THE DEPOSITION OF RIVER SEDIMENTS ON THE NEARSHORE ZONE AND EVALUATION OF THE STABILITY OF THE SUBMARINE FAN,
Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
For primary bibliographic entry see Field 2J.
W83-02251

SURVEY, ECOLOGY, AND SYSTEMATICS OF THE UPPER POTOMAS ESTUARY BIOTA: AUFWUCHS MICROFAUNA - PHASE III,
Georgetown Univ., Washington, DC. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W83-02291

SHELF AND SLOPE CURRENTS OFF NEWPORT BEACH,
Southern California Coastal Water Research Project Authority, Long Beach.
T. Hendricks.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 247-257, 4 Fig, 3 Tab.

Descriptors: *Water currents, *Water depth, *Ocean bottom, *Flow rates, *Longshore currents, Outfall, Average flow, Flow velocity, Coastal waters, Coastal zone management, Variation coefficient, Current meters, Tidal currents.

The characteristics of the currents in the vicinity of an ocean outfall influence the dilution of the wastewater and the dispersion and sedimentation rates of effluent particulates to the ocean bottom. Current measurements on the shelf and slope area off Newport Beach were made to obtain data on mid-water and near-bottom currents; to determine the properties of the currents in deeper water (so the feasibility and advisability of extending outfalls can be explored); to examine inter-annual current variability; and to add to the data on currents in the southern California Bight. Current meter moorings were set at three locations in depths from 55 meters to 351 meters. Measurements were collected at mid-water and 1-2 meters from the bottom. Speed distributions were also recorded for median speed, most probable speed, etc. and at what depths they were observed. Near the bottom, net speeds were in the range of 1-3 cm/sec. Peak speeds tend to be higher on the shelf than in deeper water but this may reflect the longer record lengths available for the shelf area. A striking feature is that the current strengths at 250 meters (in 300 meters of water) are comparable with those at a depth of 40 meters in 55 metrers of water. Based on model studies comparing sedidentation rates of effluent particulates in the Newport Beach and Palos Verdes areas, it is expected that sedimentation rates could be enhanced at the slope station due to reduced cross-shore fluctuations and the effect of the sloping bottom. There is also the indication that although the net speed of mid-water flows at 150 meters are larger than on the shelf or lower on the slope, the near-bottom speeds are less than at other two sites. (Atkins-Omniplan)
W83-02307

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION; VOLUME IV, WATERSHEDS AND BASINS.
Jones and Stokes Associates, Inc., Sacramento, CA.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-80/48-1 and -2, October 1981. In two reports, 1395 p 317 Fig, 381 Tab, 499 Ref. 14-16-0009-79-043.

Descriptors: Ecology, *Environment, *Estuaries, *Coasts, *Watersheds, *California, Geology, Hydrology, Water quality, Soil types, Distribution, Spawning, Anadromous fish, Social aspects, Economic aspects.

The study area includes coastal California from the Oregon border south to Point Conception and from the minus 1,000 m contour line offshore inland to the crest of the coastal mountain ranges. A separate chapter was prepared for each of 22 watersheds and five offshore basins; and each contains site-specific information. Chapters on the watersheds contain information on terrestrial, freshwater, and estuarine physical-chemical processes and features, biological resources, and socio-economic activities. Chapters about the basins contain information on intertidal, pelagic and subtidal benthic physical-chemical processes and features, biological resources, and socio-economic activities. Watershed chapters contain descriptions of geology, soils, climate, tsunami hazard, hydrology, water quality, and other topics. The biological resources section of each watershed description contains information on selected species and areas of ecological concern. Preserves, reserves, refuges, conservation areas, sites of known scientific and educational value, anadromous fish spawning areas, wild and scenic rivers, important nesting sites, and waterfowl and shorebird concentrating locations are described and mapped as areas of ecological concern. (Moore-SRC)
W83-02311

ALBEMARLE SOUND - TRENDS AND MANAGEMENT NEEDS.
For primary bibliographic entry see Field 5G.
W83-02325

AMMONIUM IN THE DUWAMISH ESTUARY: NITRIFICATION, SEDIMENT RELEASE AND TOXICITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02368

MATHEMATICAL MODELING AND PARAMETER IDENTIFICATION IN A TWO DIMENSIONAL ESTUARY: CASE STUDY OF THE HYDRAULIC MODEL OF THE SAN FRANCISCO BAY AND DELTA,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. S. Chu, and W. W. G. Yeh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187146, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Contribution No 183, March 1981. 38 p, 10 Fig, 5 Tab, 47 Ref. OWRT B-191-CAL(3).

Descriptors: *Mathematical models, *Esturaries, Hydrodynamics, Tidal energy, Dispersion, Numerical analysis, Salinity, *California, *San Francisco Bay-Delta, Model studies, *Hydraulic models, Simulation analysis, Suisun Bay, Conjunctive use, Optimization.

This report presents a study of conjunctive use of mathematical and physical models for estuarine hydrodynamics and salinity transport simulation. Two sets of mathematical models are developed which are capable of simulating both the inter-tidal and intra-tidal conditions as represented by an existing, well-calibrated hydraulic model. Suisun Bay, a significant portion of San Francisco Bay, is selected as a study area for this project. Data collected from the physical model which contain relatively less noise are used to calibrate the mathematical models by an automatic optimization routine. The calibrated parameters are used for verification using a different set of data collected from the hydraulic model. Both calibration and verification compare favorably with observations. This report identifies a number of discrepancies in the general use of both mathematical and physical models based on the findings of this study. (Snyder-California)
W83-02407

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

NOVEL POLYMERS FOR REVERSE OSMOSIS MEMBRANES,

SRI International, Menlo Park, CA.
J. F. Wolfe, R. S. Jones, and P. D. Sybert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173237, Price codes: A04 in paper copy, A01 in microfiche. Technical Report, November 1982. 48 p, 16 Fig, 7 Tab. OWRT C-00139 -S(No 0465)(1), 14-34-0001-0465.

Descriptors: *Polymers, *Desalination, *Reverse osmosis, *Membranes, Thin film composite membranes, *Chlorine resistant membranes, Piperazine prepolymers.

A family of tertiary polyamide prepolymers was sought in an effort to develop new chlorine-resistant reverse osmosis (RO) membranes and to determine the relationship of the molecular structure and morphology of the membrane with its RO performance. Although the first two approaches did not give a general synthetic method from which a family of prepolymers could be prepared, three prepolymers (TRIPIP, DIPIP-10, and DIPIP-50) were synthesized and tested. A suitable method was found based on the synthesis of a tetramine monomer which has two of the amine groups protected. Polymerization with subsequent deprotection afforded an oligomeric polyamide with pendant piperazine groups spaced along the polymer backbone. Although the prepolymer afforded interfacial films for membrane studies, they were weak and did not adhere adequately to the polysulfone support. This method can be used to prepare membrane prepolymers with a variety of piperazine functionality, rigidity, hydrophilicity, and molecular weight. Techniques were developed for the preparation of thin film composite membranes (TFCM) by in situ reactions and identification of the important processing variables. Using polyethyleneimine/isophthaloyl chloride (PEI/IPC), the effects of varying PEI molecular weight were examined, and a variety of microporous polysulfone supports were studied. TFCMs were prepared using an oligomeric, piperazine-capped polyamide, DIPIP-50. These membranes were evaluated for chlorine resistance with both static and dynamic testing procedures. The testing mode proved to be critical in determining the membrane lifetime in an aqueous hypochlorite environment. DIPIP-50 based membranes do not exit adequate chlorine resistance under simulated working conditions.
W83-02132

PERMSELECTIVE MEMBRANES FROM POLYIMIDES AND AROMATIC POLYAMIDES,
Research Triangle Inst., Research Triangle Park, NC.
A. Schindler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178046, Price codes: A11 in paper copy, A01 in microfiche. Completion Report RTI/2063/00-01F, September 1982. 232 p, 61 Fig, 85 Tab, 29 Ref. OWRT C-00131-S(0464)(1), 14-34-0001-0464.

Descriptors: *Reverse osmosis, *Membrane processes, *Polymers, *Permselective membranes, *Desalination, Chlorine, Sodium hydroxide, Hyperfiltration, Polyimide membranes.

Reverse osmosis membranes possessing asymmetric morphology were fabricated from polyimides and polyamides of various chemical structures. These asymmetric membranes were characterized as to their morphology, chemical stability, thermal stability and hyperfiltration properties. The degradation of the polyimides derived from pyromellitic dianhydride and diaminodiphenyl ether (P-DDE) and diaminodiphenylether diphenylsulfone (P-SEDI) was studied in hot water, 10% sodium hydroxide and 5% sodium hypochlorite. The P-SED1 film was more stable to chlorine than the P-DDE film. P-SED1 was also more stable to sodium hydroxide. Overall, the reverse osmosis properties of the polyimide membranes indicated that as a class of polymers they are not very good candidates for desalination membranes. The aromatic polyamide structure- hyperfiltration property relationship was studied. Symmetrical aromatic diamines incorporated in the polyamide structure resulted in low flux, high rejection membranes. Asymmetric substituted aromatic diamines incorporated in the polyamide structure results in high flux and lower rejection. Methods for the preparation of high molecular weight N-substituted aromatic polyamides were evaluated. The N-methylated polymers prepared were observed to be poor materials for the fabrication of reverse osmosis desalination membranes. The polymer N,N'-piperzine-bis(4-hydroxybenzamide) exhibited excellent thermal stability and chlorine stability. (Moore-SRC)
W83-02222

3B. Water Yield Improvement

ECONOMIC ANALYSIS OF ALTERNATIVE DOMESTIC WATER SUPPLIES,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W83-02369

WATER AS A CONSTRAINT ON AGRICULTURAL DEVELOPMENT IN THE SEMI-ARID AREAS OF TANZANIA,
Dar es Salaam Univ. (Tanzania). Dept. of Geography.
J. D. Kaduma.
Water Supply and Management, Vol 6, No 5, p 417-430, 1982. 2 Fig, 2 Tab, 11 Ref.

Descriptors: Water resources development, *Irrigation water, *Groundwater availability, *Tanzania, *Semiarid lands, Agriculture, Evapotranspiration, Rivers, Drainage, Surface drainage, Water supply, Groundwater irrigation, Groundwater potential, *Developing countries.

Groundwater irrigation is regarded as the answer to stabilization of agriculture in semiarid areas of Tanzania. To date groundwater resources are not used on a widespread basis. Difficulties in developing this resource are the lack of data on groundwater location, depth, and quality; the extreme variability in lithology and structure; the existence of small, localized water bodies hard to detect by geophysical and satellite imagery; and lack of funds and experienced personnel. However, exploitation is possible because the igneous and metamorphic rocks underlying the semiarid zone are extensively weathered, fractured, faulted, and jointed to the depth of 150 m in some places. Other irrigation water sources are unavailable. Rainfall (200-800 mm a year) is very unpredictable and sporadic, precluding storage of runoff. The regions's two major rivers, Pangani and Great Ruaka, are regulated for hydroelectric power production, leaving very little water for irrigation purposes. Many streams, lakes, and swamps are ephemeral and/or brackish. The black clay soils impede drainage, crack when dry, and swell quickly upon wetting. The remainder of the soil is sand or sandy loam. Other factors inhibiting a stable agriculture are the large sections designated as national and state forest and game reserves; settlements built to take advantage of permanent waters, depriving nomads of their customary dry season watering places; and high evapotranspiration. (Cassar-FRC)
W83-02396

3C. Use Of Water Of Impaired Quality

EPIDEMIOLOGIC IMPACT OF WATER REUSE IN LOS ANGELES COUNTY,
California Univ., Los Angeles. School of Public Health.
R. R. Frerichs, E. M. Sloss, and K. P. Satin.
Environmental Research, Vol 29, No 1, p 109-122, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Public health, *Drinking water, *Recycled water, Groundwater recharge, Water shortage, Water supply development, Water conservation, Percolation, Advanced wastewater treatment, Water pollution sources, *Water reuse, Los Angeles County, *California.

The importance of recycled wastewater in the pathogenesis of disease has been considered in an ecologic analysis of four geographic areas of Los Angeles County. Two of the areas received recycled wastewater via the groundwater since 1962, while two similar areas served as controls. Of 19 health outcomes included in the analyses, five exhibited statistically significant differences among four areas. In none of these five analyses, however, were the differences in accord with the biologic hypothesis that recycled water causes disease. For only one outcome, deaths due to cancer of the rectum, were differences noted in which the high recycled water area had more excess deaths than the low recycled water area, and both had more excess deaths than the control areas. This positive association was of low order, however, and might have been due to chance. The results of this first stage of the study suggest that as of 1969-1971, there were no grossly apparent adverse health effects associated with the use of recycled water. Nonetheless, a cautious interpretation of the study findings is necessary due to the inherent limitations of this type of analysis. (Baker-FRC)
W83-02105

ECOLOGY AND PATHOLOGY OF WILDLIFE IN RESPONSE TO SPRAY IRRIGATION OF CHLORINATED SEWAGE EFFLUENT-PHASE II,
Pennsylvania State Univ., University Park. School of Forest Resources.
G. M. Kelly, J. S. Wakeley, W. H. Neff, H. Rothenbacher, and G. L. Storm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173260, Price codes: A05 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, Pennsylvania State Univ., University Park, Completion Report, September 1982. 86 p. OWRT B-105-PA(4), 14-34-0001-8111.

Descriptors: *Effluent spraying, *Sewage effluents, Wildlife, Pathology, Ecology, Monitoring, Microenvironment measurements, Habitats, Birds, Mammals, *Pennsylvania, *Spray irrigation, *Faunal responses, *Wastewater irrigation, *Cottontail rabbits, Post-spray areas, Avian Community, Parasite incidence, Species, Strata.

Prior to chlorinated effluent spraying on a 200 ha area, research concentrated on developing techniques to monitor changes in wildlife populations and habitats and collecting a data base for comparison with post-spray information. Cottontail rabbits were radio-tagged and followed throughout the year. Home ranges, movements and habitat use were determined and microenvironment measurements were made at rabbit bedsites. Selected quantative histologic measurements were made and compared with various body and blood parameters to determine whether they could be used to define the health status of cottontail rabbits. Necropsied rabbits were examined for endoparasites, pathological changes and blood parasites. Differences in parasite incidence and pathology were found among seasons and between sexes and study areas. The ectoparasite fauna on cottontail rabbits from the study area was documented. Feulgen DNA and azure B RNA cytophotometry were used to do quantitative histochemical analysis of changes in nucleic acid levels in hepatocytes of cottontail rabbits. A study of the relationship between passerine bird distribution and abundance and vegetation present in the pre-spray area suggests the effluent spraying will probably impact the avian community. As understory and midstory vegetation change due to spraying, the numbers and distribution of species living in those stata will also change.
W83-02135

3D. Conservation In Domestic and Municipal Use

RESIDENTIAL WATER CONSERVATION IN A NONCRISIS SETTING: RESULTS OF A NEW JERSEY EXPERIMENT,

Wisconsin Univ.-Stevens Point. Dept. of Economics and Business.
D. J. Palmini, and T. B. Shelton.
Water Resources Research, Vol 18, No 4, p 697-704, August, 1982. 5 Tab, 13 Ref.

Descriptors: *Water conservation, *Municipal water, Water supply, Conservation, Water management, Domestic water, Resources management, Planning, *New Jersey, Cost savings.

A limited retrofit water conservation program conducted by a small suburban community in New Jersey is reviewed. The program started in 1980 by distributing to 564 households free packets of water saving devices purchased with municipal funds. The program was not a response to a current water supply crisis, and appeals for cooperation were based on the private economic benefits of water conservation. Statistical procedures were developed to measure the proportion of households installing each of the devices distributed, water savings and program costs. Two-thirds of the households receiving the packets installed at least one device. Average annual water savings per home receiving a packet were estimated at 5010 gallons (18.96 kl). Amortized over ten years at a 10% discount rate, the program cost was about 35 cents/1000 gallons of water saved. The results compared well to results obtained from similar conservation programs in a pair of California communities during the 1976-77 drought. (Baker-FRC)
W83-02157

CONSERVATION PRACTICES AND ATTITUDES AMONG MARYLAND WATER SUPPLY MANAGERS,
Maryland Univ., College Park. Dept. of Geography.
S. W. Sawyer.
Water Resources Bulletin, Vol 18, No 5, p 791-796, October, 1982. 22 Ref.

Descriptors: *Water conservation, *Water management, *Water supply, *Water demand, *Maryland, Surveys, *Attitudes, Water rates, Elasticity of demand, Water metering, Political constraints, Water policy, Institutional constraints.

A survey of managers at 35 Maryland water utilities indicates that they generally view conservation as a short-term response to temporary supply shortages. About 96% of all connections in the state are metered. About 1/3 of the managers have no sense of distribution of demand among residential, industrial, etc., sectors. Although most of the managers are not concerned with conservation programs, two large utilities (Howard County and Washington, D.C.) have comprehensive ongoing programs; 10 others occasionally use conservation measures. In case of a hypothetical 15% increase of demand, 14 of the 20 managers whose systems could not supply additional water favored an increase in supply capacity without conservation measures. Most managers do not approve of increasing step or block rate schedules to curb excessive water demand. Reasons for these attitudes are: (1) Maryland is seen as a water-rich area, (2) many systems have excess capacity because of firefighting regulations, (3) public opposition to conservation, (4) the association of conservation with reduced revenue and rate changes, and (5) low priority of water supply issues within the local governments. If water conservation is to be practiced widely in this region, the constraints affecting managers' attitudes must be addressed and the benefits of conservation must be better documented and communicated. (Cassar-FRC)
W83-02171

CONSUMER ADOPTION OF WATER CONSERVATION MEASURES: PERCEPTIONS AND INCENTIVES,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
J. H. Simms, D. D. Baumann, J. J. Boland, A. Alley, and B. Kranzer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180349, Price codes: A10 in paper copy, A01 in microfiche. Report, 1982. 200 p, 3 Fig, 51 Tab, 61 Ref, 4 Append. OWRT C-90210-C (No 9457)(1), 14-34-0001-9457.

Descriptors: Conservation, Pricing, Forecasting, *Consumer acceptance, *Water use, Climate, *Demand managment, *Water conservation, Arizona, Tucson, Colorado, Aurora, Illinois, Elmhurst, Indiana, Indianapolis.

The purposes of this study were to: First, identify factors that influence consumer adoption of water conservation measures; second, to determine the effectiveness of adopted conservation measures, that is, the extent to which they result in reduction in water use. Conservation measures were classified as voluntary residential, either behavioral (such as reduced lawn watering) or technological (such as low-flow toilets), or as community-imposed (mandatory). A stratified-random sample of 1383 residents from four cities was interviewed during the summer of 1980: data on 56 variables were obtained which included the aridity/humidity of the site, water management/conservation policies of the site, and specific characteristics of each respondent, such as socio-economic and demographic characteristics, personal ideology, personality, experience, perception of conservation measures, pricing policy, and crisis situation. The cities were selected on the basis of climate and water conservation policy. According to climate, Tucson and Aurora represent relatively arid sites: Elmhurst and Indianapolis represent more humid areas. And, according to water conservation policy, Aurora and represent more humid areas. And, according to water conservation policy, Aurora and Elmhurst are representative of cities with more active water conservation programs and polices with Tucson and Indianapolis being relatively less active in promoting water conservation. Most consumers were aware of a wide range of measures to reduce water; that is, the public is well-informed as to what to do to effect water conservation. The single most important factor accounting for the variation in consumer adoption of water conservation measures is climate. The individual socio-economic status was the next most important factor affecting the decision to adopt water conservation. In general, the higher one's socio-economic status, the more favorable is the attitude toward water conservation and the greater the liklihood that residential water conservation measures are implemented, especially those classified as technological. Attitudes toward community-imposed measures, however, are not significantly related to socio-economic status. Personality is an influential factor in attitude toward and the decision to adopt water conservation measures. The effect conservation has on water use is complicated. Only technological measures are related to reduced water used, and then only in communities with active water conservation programs--Aurora, Colorado and Elmhurst, Illinois. There was no relationship between the adoption of behavioral measures and water use in any of the four communities, and there was no relationship between the adoption of technological measures in Tucson or Indianapolis.
W83-02297

3F. Conservation In Agriculture

EVALUATION OF A LARGE SCALE IRRIGATION SYSTEM - DAIMCHEH, IRAN,
Jordan (Edward C.) Co., Inc., Portland, ME.
M. Miremadi.
Water Resources Bulletin, Vol 18, No 5, p 749-753, October, 1982. 1 Fig, 5 Ref.

Descriptors: *Irrigation efficiency, *Social aspects, *Developing countries, *Furrow irrigation, Daimcheh, *Iran, Water conservation, Sugarcane, Soil erosion, Erosion, Sprinkler irrigation, Flow control, Water loss.

The furrow irrigation system of the Karun Agro Industry, a sugar cane project in Daimcheh, Iran, was evaluated because efficiency had been reduced by 50% since its construction 8 years previously. The system was designed to cultivate 17,000 ha of land, using 3,000 field workers. Major difficulties were the workers (lack of skill, resentment toward nationalization of their land, poverty, falling asleep on the job), night irrigation (500 generators needed, local superstitions, furrow erosion), flow control (errors causing damage to canals), loss of water (evaporation, canal seepage, and failure to close gates to the river), and soil erosion (loss of the scarce organic matter, widening of canals, clogging of soil surface with silt). Suggested improvements in the system are sprinkler irrigation, replacement of quaternary canals with gated plastic pipes, training programs, better canal maintenance, increase of canal capacity to accomplish irrigation in 2 instead of 3 shifts, and incorporation of storage reservoirs. The project, which ceased to function after the political turmoil in Iran, was the target of shelling during the Iran-Iraq war. The extent of damage is unkown to the author. (Cassar-FRC)
W83-02151

SUPPLEMENTAL IRRIGATION OF HORTICULTURAL CROPS IN THE HUMID REGION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
G. R. Sands, I. D. Moore, and C. R. Roberts.
Water Resources Bulletin, Vol 18, No 5, p 831-839, October, 1982. 9 Fig, 3 Tab, 15 Ref.

Descriptors: *Irrigation requirements, *Economic feasibility, *Cost-benefit analysis, *Supplemental irrigation, Crop yield, Model studies, Humid areas, Horticulture, Water distribution, Pipes, Wayne County, *Kentucky, Benefits, Tomatoes, Water stress, Water requirements.

A yield predictive computer model was developed to estimate water requirements for supplemental irrigation of horticultural crops (tomatoes, cabbages, peppers, and cucumbers) in humid regions of the U.S. The model consisted of several submodels: runoff, evapotranspiration-soil water, and stress index-yield. Four pipe distribution systems were designed for use in Wayne County, Kentucky, in a 4452 ha area containing widely distributed irrigated plots totaling 324 ha of horticultural crops. The systems were: (1) one pump serving the entire area of 324 irrigated ha, (2) one pump serving 259 irrigated ha, (3) one pump serving 65 irrigated ha in another section, and (4) two pumps, combining systems (2) and (3), serving 324 irrigated ha. The economic feasibility was determined for each design from capital, operational, and maintenance costs of the distribution and on-farm irrigation systems. None of the four systems proved feasible, assuming 4 acres-per-farm irrigation. However, upon increasing the area irrigated per farm and/or planting a greater percentage of high return crops such as tomatoes, the benefit-cost ratios could reach 2.9. The model predicted peak consumptive use rate for tomatoes of 6.5 mm per day at the 80% probability level. The average annual yield increase was 8.552 kg per ha, and the average seasonal water requirements were 95 mm. (Cassar-FRC)
W83-02172

ANALYSIS OF IRRIGATION PUMPING AND APPLICATION EFFICIENCY IN THE CENTRAL OGALLALA FORMATION,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
H. P. Mapp, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175331, Price codes: A06 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute Completion Report, Oklahoma State Univ., Stillwater, January 1983. 104 p, 6 Fig, 34 Tab, 46 Ref. OWRT B-048-OKLA(1), 14-34-0001-9156.

Descriptors: *Water-use efficiency, Irrigation, Conservation, *Ogallala formation, Soil moisture stress, *Irrigation timing, Plant growth modeling, Economic evaluation, *Oklahoma, Panhandle region, Sorghum, *Optimal control procedures, Crop yield, *Irrigation scheduling, Water conservation.

This study evaluates irrigation technologies designed to increase pumping and application for irrigated grain sorghum in the Oklahoma Panhan-

dle region. A dynamic grain sorghum plant growth model is incorporated into a farm level simulation model to derive the effects of alternative irrigation schedules on crop yields, water use and producer net returns. Comparisons of proposed irrigation schedules is accomplished using stochastic efficiency and optimal control procedures. Stochastic dominance analysis is used to identify risk efficient irrigation strategies that realize greater net returns on the average and are less prone to low outcomes under unfavorable conditions. A number of irrigation strategies based on reduced water applications were found to dominate contemporary irrigation practices. Optimal control procedures are used to derive the quantity of ground water use through time which maximizes returns to the producer. Optimal control procedures indicate that producers can reduce water use by 30 to 40% while maintaining crop yields and the level of net return. If these efficiences could be achieved throughout the region, substantial reductions in ground water use would result and the economic life of the water supply would be lengthened.
W83-02188

IRRIGATION SYSTEM EFFICIENCY SURVEY FOR GEORGIA,
Georgia Coastal Plain Experiment Station, Tifton.
J. R. Stansell, C. Butts, K. Harrison, and J. Garner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177972, Price codes: A03 in paper copy, A01 in microfiche. Environmental Resources Center Report Number ERC 10-82, Atlanta, Georgia Institute of Technology, October 1982. 32 p, 6 Fig, 4 Tab, 10 Ref, 1 Append. OWRT A-102-GA(1), 14-34-0001-2111.

Descriptors: *Irrigation systems, Pumping, Standards, *Coefficient of uniformity, Application uniformity, *Center pivot systems, *Pumping systems, *Georgia, *Irrigation efficiency.

Fifteen pumping systems were tested for efficiency of operation and rated according to the performance criteria published by the University of Nebraska. Overall performance rating was 83.1% of standard. Six diesel powered systems were rated at 80.5% of standard while the average performance rating for nine electrical powered systems was 85.9% of standard. The range of all ratings was 44.1 to 122.0% of standard. The Christiansen and the Heerman-Hien coefficients of application uniformity were determined for seven center pivot systems. Average coefficients for the seven systems were 83.7 and 80.7% for the Christiansen and Heerman-Hein procedures, respectively. The range of coefficients was from 71 to 88%.
W83-02212

ANALYSES OF ENERGY USED BY IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, R. H. Cuenca, K-L. Chen, R. B. Wensink, and J. W. Wolfe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178055, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, June 1982. 102 p, 20 Fig, 24 Tab, 24 Ref, 6 Append. OWRT C-7133(6224)(1), 14-34-001-6224.

Descriptors: *Irrigation, *Energy, *Computer models, *Model studies, *Irrigation design, Economic aspects, Irrigation engineering, Deficit irrigation, Water conservation, Irrigation water, Water use, Sprinkler irrigation.

A model was developed to evaluate the total amount of non-renewable energy consumed in the irrigation process. This computer model is conversational in nature, asking certain questions about the system and feeding back answers so that the modeler can make further decisions as the design process continues. The model is capable of predicting energy requirements for the following irrigation systems: handmove, center pivot, drip, side role, solid set, surface, permanent, and big gun systems. The model was used to calculate energy requirements for manufacturing, transporting, installing, operating irrigation systems. A model was developed to compare optimum energy designs to minimum economic designs for farm irrigation mainlines. The standard rule of thumb for allowable head loss in mainlines may no longer be appropriate. An analysis of the relationship between energy used for pumping and irrigation uniformity considered sprinkler spacing, wind speed and the application pattern of sprinklers. For a particular sprinkler spacing, decrease in operating and total seasonal energy can be expected with increasing uniformity coefficients. The model was used to determine the effects of static pumping lifts on minimum energy and minimum economic designs. The model was also used to analyze an irrigation system designed for deficit irrigation. It appears that, under certain circumstances, deficit irrigation may reduce energy use and water use without appreciably reducing net income. (Moore-SRC)
W83-02224

USERS MANUAL FOR COMPUTER MODEL TO PREDICT TOTAL ENERGY REQUIREMENTS OF IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, R. H. Cuenca, K-L. Chen, R. B. Wensink, and J. W. Wolfe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178061, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, June 1982. 189 p, 7 Fig, 5 Tab, 7 Ref. OWRT C-7133(6224)(1), 14-34-001-6224.

Descriptors: *Irrigation, *Energy, *Computer models, Irrigation engineering, Irrigation operation, Transportation, Head loss, Pumping, Sprinklers.

The model is capable of predicting energy requirements for eight irrigation systems: hand move, side roll, solid set, permanent, center pivot, surface, drip and big gun. The computer program continuously interacts with the irrigation analyst via a conversational input/output mode. Most standard irrigation systems can be analyzed by the model. The energy model contains 37 subroutines which determine total energy requirements by dividing each irrigation system into four basic energy-using activities: operating energy, manufacturing energy, transportation energy, and installation energy. Total dynamic head is found by summing calculated mainline friction head loss, calculated lateral friction head loss, specified sprinkler operating head, pump suction lift, elevation difference, friction loss, and height of the riser pump. The power required to pump water is determined from total dynamic head and pump discharge. Manufacturing energy is calculated by first determining the total weight of various materials in each component, then multiplying by the manufacturing energy embodied in each unit of weight of that material. Transportation energy is calculated as the sum of energy to setup the system each season and the energy required to move it during the season. Required inputs to the model include topographic information, irrigation schedule, assumed efficiencies, mainline configuration and configuration of the laterals. (Moore-SRC)
W83-02225

SOIL-VEGETATION-HYDROLOGY STUDIES. VOLUME I. RESEARCH RESULTS, SUMMARY, DISCUSSION, AND RECOMMENDATIONS,
Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.
E. L. Neff, and J. R. Wight.
Agricultural Research Results ARR-W-28, January 1983. 59 p, 19 Fig, 15 Tab, 44 Ref.

Descriptors: *Rangelands, Hydrology, *Contour furrows, *Range management, *Soil-water-plant relationships, *Montana, Precipitation, Snow, Runoff, Soil water, Vegetation, Sediment concentration, Water quality.

As part of cooperative research on rangelands with fine-textured soils conducted in southeastern Montana from 1968 to 1981, three research sites of about 40 acres each were selected in Carter County. Project site 1 was on a saline-upland range and sites 2 and 3 were on claypan range. Of the 16 2-acre watersheds constructed on the sites, 8 were treated by contour furrowing and 8 were left untreated. About 60% of the average annual precipitation each year occurred during 16 days in which daily rainfall was greater than 0.3 inch, 20% occurred as smaller storms, and 20% occurred as snow. Annual runoff from the untreated watersheds averaged about 5.7 inches from the saline-upland range site and about 4.0 inches from the claypan range site. Annual runoff from the contour furrowed watersheds averaged about 2 inches. Contour furrowing significantly increased soil water content by trapping snow and reducing runoff. Sediment concentration in runoff from the saline-upland site averaged about 1,700 ppm from both the untreated and contour furrowed watersheds. Sediment concentrations from both the untreated and contour furrowed watersheds on the claypan site averaged about 400 ppm. Contour furrowing on the claypan range sites increased average annual herbage yields 93% and 243% on sites 2 and 3, respectively. (Moore-SRC)
W83-02315

CONSERVATION IN LONG TERM CONJUNCTIVE USE: IRRIGATION DEMANDS USING DISAGGREGATE CHOICE MODELS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 4B.
W83-02320

CONSUMPTIVE WATER USE RESPONSE OF MAIZE TO CHANGES IN ENVIRONMENT AND MANAGEMENT PRACTICES: SENSITIVITY ANALYSIS OF A MODEL,
California Univ., Los Angeles.
For primary bibliographic entry see Field 2I.
W83-02340

EVALUATING A PORTABLE INSTRUMENT FOR DETECTING DROUGHT AND SALINITY STRESSES IN PLANTS THROUGH CHANGES IN LEAF OPTICAL PROPERTIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. E. Hall.
California Water Resources Center Completion Report, Univ. of California, Davis, March 1983, 24 p, 8 Fig, 7 Tab. OWRT B-219-CAL(1).

Descriptors: *Water deficit, Irrigation, *Crop yield, Growth, Water use, Beans, Soil water, *Instrumentation, *Plant-water stress, Drought, *Irrigation management, *Leaf optical properties, Soil-water-plant relationships.

During the summer of 1981, a field experiment was conducted at Riverside, CA in which cowpeas were subjected to different levels of planned-water-deficit irrigation. Crop yield, growth, and water use were determined and methods for irrigation management, based upon weather, soil, and plant measurements, were compared. The experiment demonstrated that planned-water deficits, involving withholding irrigation from plant emergence to the first appearance of flower buds, substantially reduced water use from 102 to 179mm without affecting the yield of dry beans (a small yield increase of 3% was obtained compared with full season irrigation). During flowering and pod filling, the irrigation schedule which maximized water-use-efficiency while maintaining maximum yields subjected plants to a moderate water deficit. Nominal depletion of available soil water, estimated from predictions of crop water use, provided the most practical procedure by which farmers could manage irrigation of cowpeas. Tensiometers also provided adequate data for guiding irrigation. Pressure chamber, leaf conductance, canopy temperature, and near infrared reflectance measurements did not provide adequate data for guiding irrigation under commerical conditions. (Snyder-California)
W83-02363

INCREASING RETURNS FROM WATER AND NITROGEN APPLIED TO IRRIGATED LANDS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
P. L. Carson, and D. L. Beck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187138, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, South Dakota State Univ., Brookings, December 1982. 40 p, 9 Fig, 10 Tab. OWRT B-063-SDAK(1), 14-34-0001-0249.

Descriptors: *Nitrogen, Nitrates, Nitrogen cycle, Demineralization, *Fertilizer requirements, *Corn, *Crop yield, *Irrigation practices, Computer models, *South Dakota, Model studies.

A field study was conducted in 1979 and 1980 to develop and test models predicting high yield irrigated corn response to nitrogen and water management techniques. Grain yield, leaf nitrogen content at silking and grain nitrogen content were predicted using fertilizer additions, soil nitrates in a 120 cm profile subsampled by depth, soil/water matric potential as measured by tensiometers and various other parameters. Percent attainment of maximum potential yield was also described in terms of leaf N and grain N contents as affected by soil/water matric potential. The models were developed at a researcher managed area using soil/water matric potential levels of -35, -50 and -75 kPa with fertilizer treatments of 0, 100, 200 and 400 kg/ha on this site testing low in soil nitrate. Soil matric potential, over the range tested, had no effect on the amount and N supplied by mineralization at that site. Yield, leaf N and grain N all increased as a cubic function with fertilizer additions. Leaf N and grain N increased as soil/water potential decreased. Grain yield increased as water potential increased. A yield of 13,500 kg/ha of grain was achieved at both the 200 and 400 kg/ha N levels under the -35 kPa water treatment. The atmospheric demand conditions of the two years were quite different causing a larger response to water treatment in 1979 than 1980. Seventeen cooperator sites varying in years irrigated from 0 to 14 were included in the study. Nitrogen balance techniques indicated that net mineralization did not differ substantially over these sites. The models developed were therefore testing using this data. Good to excellent predictive capability was shown with all models being significant at the .0001 level.
W83-02406

A MODEL FOR SPRINKLER NOZZLE REPLACEMENT,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
D. Karmeli, G. Peri, and M. Todes.
Transactions of the ASAE, Vol 25, No 5, p 1284-1289, September/October, 1982. 8 Fig, 4 Ref.

Descriptors: *Sprinkler irrigation, *Nozzles, *Maintenance, Cost analysis, Irrigation practices.

A model has been developed for sprinkler maintenance by periodic nozzle replacement. The model yields the optimal replacement time of regular nozzles and the optimal installation time of flow regulated nozzles, with respect to water wasted due to nozzle wear and pressure variation. These optimal times are dependent on sprinkler operating parameters such as the cost of the nozzle with respect to the cost of water, the discharge, the pressure, the lifespan of the sprinkler and the effective lifespan of the nozzle. For regular nozzles, savings in the range of 80 to 90% of the cost of water wasted due to nozzle wear can be achieved by regular nozzle replacement. For flow regulated nozzles, savings in the range of 90 to 99% of the cost of water wasted due to both nozzle wear and pressure variation can be achieved. (Baker-FRC)
W83-02420

MODELING SOIL MOISTURE AND EFFECTS OF BASIN TILLAGE,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
F. I. Idike, C. L. Larson, and D. C. Slack.
Transactions of the ASAE, Vol 25, No 5, p 1262-1267, September/October, 1982. 5 Fig, 5 Tab, 21 Ref.

Descriptors: *Soil moisture, *Basins, *Tillage, *Model studies, Water availability, Moisture availability, Water stress, Crop yield, Precipitation, Infiltration, *Corn.

Attempts were made to develop a model capable of predicting soil moisture levels in a field under corn production throughout the growing season and to determine by the use of this model whether basin tillage could increase soil moisture levels in areas where rainfall during the growing season is limiting. The model developed performed very well for most years, with the poorest predicted moisture content values for the year usually falling within 0.10 (vol/vol) of the observed values. The study concluded that the model satisfactorily predicted soil moisture levels in the field under corn production throughout the growing season and provided a basis for studying the effects of various practices on soil moisture. At both locations, application of the model indicated that the year round use of basin tillage increased soil moisture and decreased crop stress substantially as compared to conventional tillage. The increase in soil moisture content produced by basin tillage could be attributed to surface storage of excess precipitation during the growing season or the off-season, or both, depending on the location. (Baker-FRC)
W83-02422

CABLEGATION: III. FIELD ASSESSMENT OF PERFORMANCE,
Idaho Univ., Kimberly. Twin Falls Research and Extension Center.
M. C. Goel, W. D. Kemper, R. Worstell, and J. Bondurant.
Transactions of the ASAE, Vol 25, No 5, p 1304-1309, September/October, 1982. 10 Fig, 5 Ref.

Descriptors: *Flow rates, *Irrigation practices, *Cablegation, Runoff, Steady flow, Furrows, Irrigation ditches, Flow discharge, Runoff rates, Flow profiles, Ditches.

An evaluation is presented of performance of a cablegation system in terms of orifice discharges, advance of water with time in the furrows and flow into and out of the furrows. Furrow infiltration rates are also reduced as a function of time, and their interaction with the distribution system is discussed. Seventy-three percent of the water applied to the field infiltrated. Intake opportunity times averaged 11.0 hr at the top end and 8.3 hr at the bottom. The furrow intake rate was related to the average intake opportunity time. From these data it can be calculated that water applications at the bottom of the field averaged 84% of the application at the top end. Runoff rate was relatively constant and total runoff was only about half of that which would have occurred under fixed set surface irrigation. Variability of furrow infiltration rates was high, and 10% reduction in furrow supply rates would have resulted in water not reaching the ends of some furrows. In general the cablegation system provides more uniform water application than is normally achieved with other surface irrigation systems. The automatic cutback in supply reduces runoff, and the runoff is more easily reused because of its steady flow. (Baker-FRC)
W83-02437

IRRIGATION SCHEDULING PROCEDURE FOR SUBHUMID AREAS,
Missouri Univ.-Columbia. Dept. of Agricultural Engineering.
J. M. Gregory, and R. W. Schottman.
Transactions of the ASAE, Vol 25, No 5, p 1290-1294, September/October, 1982. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Irrigation practices, *Subhumid climates, Climates, Woodruff chart, Crop yields, Corn, Soybeans, *Missouri, *Irrigation scheduling.

A simple procedure for developing an irrigation scheduling chart has been developed for the subhumid climatic conditions typical of Missouri. The procedure is easily programmed on a computer for construction of individualized irrigation charts or tables. The Blaney-Criddle technique, one of many procedures for predicting consumptive use, was modified for the high humidity levels found in Missouri. Basic concepts of the Woodruff method which were retained include annual soil water recharge, excess rainfall in May and gradual depletion of soil moisture after June 1. The new method allows for variable planting data and crops other than corn. This method was developed for the claypan conditions in Missouri and should be checked if applied to other areas. (Baker-FRC)
W83-02438

SPRINKLER IRRIGATION UNIFORMITY REQUIREMENTS FOR THE ELIMINATION OF LEACHING,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
R. A. L. Brito, and L. S. Willardson.
Transactions of the ASAE, Vol 25, No 5, p 1258-1261, September/October, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Water supply, *Leaching, *Sprinklers, Irrigation, Irrigation rates, Sprinkler irrigation, Zero leaching.

The objective of this study was to set guidelines for management of sprinkle irrigation for simultaneously maintaining crop growth and a condition of zero leaching. It was determined that zero leaching can be accomplished with a sprinkler system by reducing the average application amount to prevent any over-irrigation. The minimum required application is then controlled by the water requirement to keep the plants alive. The coefficient of uniformity is the adjustable parameter examined to obtain the required water application uniformity. When a zero leaching situation is desired and a minimum water application rate is required from a sprinkler system, an estimation of the minimum coefficient of uniformity (CU) necessary for the system can be obtained. Once the minumum water application ratio is decided upon, the given table then shows which minimum CU is recommended for the system and what upper and lower limits of water application should be observed to avoid unacceptable extremes. (Baker-FRC)
W83-02439

EMITTER PLUGGING AND DRIP IRRIGATION LATERAL LINE HYDRAULICS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, I-P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 25, No 5, p 1274-1281, September/October, 1982. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Drip irrigation, Hydraulics, Irrigation, Irrigation practices, Fluid mechanics, Flow, *Lateral lines, *Emitter plugging.

The effects of emitter plugging on drip irrigation lateral line hydraulics were evaluated for both single-chamber and dual-chamber lateral lines. Theoretical equations were developed to show the relationship between the percentage of plugging and the percentage of total flow. Both the theoretical analysis and laboratory measurements were based on an assumption that the plugging position along a lateral line is uniformly distributed. The theoretical curves and laboratory measurements showed very close agreement. The relationship between the percentage of total flow and the percentage of plugging for single chamber lateral lines was very close to a direct proportion. The relationship between the percentage of total flow and the percentage of plugging for dual-chamber lateral lines was found to be dependent on the design ratio of inner to outer orifices. Theoretical curves were developed for predicting emitter plugging rates based on the change in lateral line flow. (Baker-FRC)
W83-02440

PROBLEM OF IRRIGATING RICE FIELDS,

All-Union Scientific Research Inst. of Rice (USSR).
V. B. Zaitsev.
Water Resources, Vol 9, No 1, p 44-52, January-February, 1982. 3 Fig, 5 Tab, 10 Ref. Translated from Vodnye Resursy, No 1, p 83-93, January-February, 1982.

Descriptors: *Rice, *Irrigation requirements, *Water use efficiency, Water conservation, Irrigation efficiency, Crop yield, *USSR, Seepage control, Water reuse, Pesticides.

Water duties for rice crops in Russia vary by 15,000-20,000 cu m per ha in different regions and within regions. Climatic conditions should account for only 2000 cu m per ha of this difference. Other factors having influences on water duties are hydrogeological conditions, design and quality of the system, and the efficiency of operation. River irrigation in the Petrovka-Anastasievka systems was studied from 1955, the second year of operation, to 1979. The duty decreased from 32.600 cu m per ha in 1955 to 17,300 cu m per ha in 1960 and remained at 16,100-16,700 cu m per ha until the end of the study. Rice yields (centners per ha) were 10.0 in 1955, 21.4 in 1960, and 33.3-46.2 until the end of the study. The decrease in duty and increase in yield were attributed to decreases in the zone of aeration, decreases in seepage from paddies and canals, reworking and compacting of soil with time, and increase in skills of persons operating the system. Systems in the same Krasnodar Territory had different average water duties and yields for 1971-75: Kuban, 18,800 cu m per ha duty and 50.5 centners per ha rice; Afipskii, 12,300 cu m per ha duty and 46.9 centners per ha rice. These differences are caused by variations in elevation, seepage losses, and soil and groundwater regimes. After stabilization of duties, further reductions can be attained by reusing waste waters, further improvement in operators' skills, elimination of large terracing, seepage control, elimination of nonproductive discharges of irrigation water, use of soil herbicides, and use of evaporation depressors. These measures should be applied first to regions with the highest duties. For some locations, improvement of existing systems will not be economical. The minimum duty calculated for the 45-47 degree North region in the USSR is 13,000 cu m per ha, slightly greater for the more southern regions. (Cassar-FRC)
W83-02447

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PRELIMINARY DESIGN ON THE MUSKEG DRAINAGE SYSTEM AT ONAKAWANA, ONTARIO,

Calgary Univ. (Alberta). Dept. of Civil Engineering.
I. Muzik.
Canadian Journal of Civil Engineering, Vol 9, No 3, p 367-377, 1982. 12 Fig, 3 Tab, 16 Ref.

Descriptors: *Drainage systems, *Muskeg, Bogs, Wetlands, Drainage, Watersheds, Snowmelt, Rainfall, Runoff, Surface runoff, Estimating, Model studies, Kinematic waves, Waves, Kinematic wave theory, Mathematical studies, *Ontario.

A hydrologic study was undertaken for the planning and sizing of drainage structures in connection with a proposed coal mine at Onakawana in northeastern Ontario. The proposed mine site is blanketed by a layer of muskeg with an average thickness of 1.5 m. Dewatering of the muskeg is needed to facilitate mining procedures. Muskeg drainage systems must also efficiently handle surface runoff due to rainfall and snowmelt. A hydrological analysis of the muskeg and a hydrologic design for its drainage system are presented. Surface runoff quanitities were estimated by means of the rational method and a kinematic wave model of overland flow. A modified Glover-Dumm equation was used to calculate the ditch spacing required for dewatering. A simplified kinematic wave model of overland flow and the rational method have been found to be the most suitable methods for estimating design peak flow rates from small areas. (Baker-FRC)
W83-02101

EVALUATION OF DROUGHT POTENTIALS AND DAMAGES IN THE NORTHEASTERN UNITED STATES,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W83-02141

OPTIMAL REAL-TIME RESERVOIR SYSTEMS OPERATION: INNOVATIVE OBJECTIVES AND IMPLEMENTATION PROBLEMS,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
E. K. Can, M. H. Houck, and G. H. Toebes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173336, Price codes: A07 in paper copy, A01 in microfiche. Technical Report Number 150, November 1982. 137 p, 19 Fig, 22 Tab, 53 Ref. OWRT B-125-IND(1), 14-34-0001-1223.

Descriptors: *Reservoir operation, *Optimization, Objective function, Flood routing, Streamflow forecasting, *Kentucky, Four reservoir system, Model studies, *Real-time operation, *Goal programming, Green River Basin System, Nonlinearity.

This study deals with the optimization of real-time operations of reservoir systems and the associated implementation problems of these optimization models. A new method for determining optimal real-time operations of reservoir systems using preemptive goal programming is proposed and applied to a four reservoir system in Kentucky. Three methods are presented to handle the nonlinearity due to the maximization of hydropower. All three methods are approximations to a nonlinear optimization problem. The existence of some of the implementation problems of real-time reservoir operations models is demonstrated by examples. The problems that are studied are the effects of using approximate reach routing models, imperfect streamflow forecasts and incorrect objective functions in real-time operations of reservoir systems.
W83-02142

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,

Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
For primary bibliographic entry see Field 6A.
W83-02147

CALCULATION OF MAXIMUM SPRING FLOOD DISCHARGES IN THE OKA BASIN,

Gidrometerologicheskii Inst., Odessa (USSR).
E. D. Gopchenko, and T. A. Simonova.
Water Resources (English Translation), Vol 8, No 6, p 591-597, November-December, 1981. 4 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No 6, p 54-61, November, 1981.

Descriptors: *Flood discharge, *Mathematical equations, *Model studies, River basins, Oka basin, Seasonal variation, Hydrographs, Floods, Flood flow, *USSR.

Among the formulas used for calculating the maximum discharges of the spring flood, of greatest practical interest are the volume formulas, based on a geometrical schematization of the shape of the flood hydrograph in the form of a triangle, two parabolas, or other figures. Unlike the reduction formulas which express the dependence of the rate of maximum runoff on the drainage area or concentration time, these volume formulas more completely take into account the factors involved and make it possible to reflect individual characteristics of the drainage basins in an explicit form. A study was made using data of observations of the maximum runoff of the spring flood in the Oka basin to calculate maximum spring flood discharges. (Baker-FRC)
W83-02237

METHOD OF CALCULATING A COMPLEX OF WATER CONSERVATION MEASURES IN THE CASE OF INTERBASIN WATER TRANSFER,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
For primary bibliographic entry see Field 5G.
W83-02240

APPROXIMATE ANALYTIC SOLUTION OF THE TRANSIENT FREE-SURFACE FLOW PROBLEM,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. G. Khublaryan, and O. O. Yushmanova.
Water Resources (English Translation), Vol 9, No 1, p 64-69, January/February, 1982. 4 Fig, 7 Ref. Translated from Vodnye Resursy, No 1, p 107-112, January/February, 1982.

Descriptors: Mathematical equations, *Model studies, Hydrodynamics, Flow, Environmental effects, Water management, Seepage, Irrigation, Reservoirs, Canals, Water table, *Surface flow.

An approximate method of solving the boundary-value problem when a free boundary is presented. An estimate is given of its accuracy by comparing the results of the approximate analytic solution with the numerical solution. When modeling water management systems and predicting their effect on the environment a quite important role is played by the choice of the mathematical model reflecting a particular physical process. This is particularly important when studying seepage from irrigated lands, reservoirs, and canals and when investigating their effect on the water table. (Baker-FRC)
W83-02253

DETERMINATION OF SEEPAGE LOSSES FROM THE NORTH CRIMEAN CANAL,

Ukrainskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Kiev (USSR).
R. A. Belenko, I. I. Il'in, Yu. A. Mikhailov, and I. S. Shpak.
Water Resources (English Translation), Vol 9, No 1, p 70-75, January/February, 1982. 3 Fig, 2 Tab, 13 Ref. Translated from Vodyne Resursy, No 1, p 113-119, January-February, 1982.

Descriptors: *Water loss, *Canals, *Water-balance method, Irrigation, Hydrodynamics, Model studies, Runoff, Drawdown, Infiltration, Groundwater recharge, Groundwater, *Seepage, North Crimean Canal, Seasonal variation, *USSR.

To determine water losses from canals it is proposed to use the method of water balance of canal stretches during short time intervals. This proposal formed the basis of a 5-year study of water losses from irrigation canals of the Crimea and from the main North Crimean canal. The essence of the proposed method consists in the continuous observation for 8-10 hrs of the income of water in the investigated stretch of the canal and runoff, its discharge by withdrawal along the length of the stretch, and change in the water level in the canal. The specific seepage from the North Crimean Canal, established by this method of the balance of the near-canal groundwater mound, varied during the irrigation season from 8 to 40 liters/sec-km. (Baker-FRC)
W83-02255

CHEMICAL AND MICROBIOLOGICAL COMPOSITION OF DRAINAGE WATERS IN FLOODPLAIN SOILS BEING DRAINED,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tomsk (USSR).
For primary bibliographic entry see Field 5B.
W83-02256

COMPARISON OF CENTRAL ASIAN CANALS AND THE SOUTHERN PART OF THE DIVERSION ROUTE OF SIBERIAN WATERS,
Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
M. K. Grave, I. A. Klyukanova, V. P. Kostyuchenko, L. M. Grave, and E. N. Minaeva.
Water Resources (English Translation), Vol 9, No 1, p 60-64, January/February, 1982. 1 Tab, 5 Ref. Translated from Vodnye Resursy, No 1, p 102-105, January/February, 1982.

Descriptors: *Canals, *Design criteria, *Construction, Water conveyance, Water distribution, Waterways, Channels, Siberia, *USSR.

Characteristics of existing large central Asian canals for comparison with works planned for diverting part of the runoff of Siberian rivers to Kazakhstan and Central Asia. These canals can be divided into two groups. Members of the first group have a reliable watertight lining or are constructed in poorly permeable rocks. These canals are economical, their regime is more controllable and their effect on the environment is limited to the irrigation sphere. Canals belonging to the second group do not have a watertight lining and are constructed in readily permeable rocks. Functioning of such canals is accompanied by an intense effect on all natural components; this effect causes both positive and negative consequences that cannot always be foreseen when planning. On comparing the existing canals with the southern part of the Main Diversion Canal (MDC) many features of similarity with respect to lithologic and geomorphologic conditions and also with respect to possible consequences of its effect on the environment are revealed. Differences are also noted which are related to the characteristics of the climate, soil cover, development of biota, and other physiographic factors. The experience of building the existing canals shows that correcting their beds when crossing sand areas gives unquestionable advantages, such as reducing water losses and providing stability of the channel. (Baker-FRC)
W83-02257

A NOTE OF CHANGES IN CHANNEL GEOMETRY AT TRIBUTARY JUNCTIONS,
Hull Univ. (England). Dept. of Geography.
K. S. Richards.
Water Resources Research, Vol 16, No 1, p 241-244, February, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Channel morphology, *Tributaries, *Hydraulic geometry, Alluvial channels, Drainage networks.

Evidence is presented to justify the assumption that channel width varies stochastically about an approximately constant mean width within a stream link of an alluvial channel. Adjustments of channel width occur predominantly at junctions, but Miller's (1958) simple model describing such changes is misleading, and an alternative is proposed whose implication is that channel width (and probably other channel dimensions) is a power function of link magnitude. It is suggested that an alternative to conventional hydraulic geometry is provided by the combination of a step function describing changes at junctions and a stochastic model of variation within individual links. (Author's abstract)
W83-02288

MICROBIOLOGICAL CONTROL OF THE AQUATIC WEED, MYRIOPHYLLUM SPP,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
H. B. Gunner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181958, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 129, Massachusetts University, Amherst, June 1982. 27 p, 11 Tab, 25 Ref. OWRT B-066-MASS(2), 14-34-001-9076.

Descriptors: *Aquatic weed control, *Myriophyllum, Aquatic plants, Aquatic bacteria, Aquatic fungi, Cyanophyta, *Biocontrol, *Cyanobacteria, *Decomposition, Water pollution control.

Bacteria, fungi and blue-green algae normally associated with the phyllosphere of Myriophyllum heterophyllum and Myriophyllum spicatum are among the principal decomposers of senescent plants. Stripped of this flora by various sterilizing techniques, the Myriophyllum extended its life by one third. The saprophytic process of decomposition was accelerated to pathogenesis by selecting from the community of microbial decomposers isolates which, when cultured on the appropriate cellulose and pectin media, could be induced to produce enzymes lytic to these tissues and ultimately lethal to the plant. That these are particularly vulnerable target tissues was confirmed by the induction of an extensive cellulolytic and pectinolytic microflora simply by the respective addition of sterile cellulose and pectin media in the test chambers which gave a significant increase in necrosis over untreated controls. In keeping with ecosystem specificity, there was a significantly higher pathogenic potential of the isolates from M. spicatum to that species than to M. heterophyllum. The results suggest that microorganisms native to the Myriophyllum ecosystem, selected for specific plant tissue attack, offer a promising avenue for the biological control of these aquatic nuisance plants.
W83-02321

RESPONSE OF HYDRILLA TO SELECTED DYES,
University of South Florida, Tampa. Dept. of Chemistry.
J. Barltrop, B. B. Martin, and D. F. Martin.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 725-735, 1982. 1 Tab, 17 Ref.

Descriptors: *Weed control, *Hydrilla, *Dyes, *Aquatic weed control, Growth, Inhibition, Submerged plants, Herbicides, Methylene blue, Hematoporphyrin, Eosin Y, Plant growth.

The dyes methylene blue, hematoporphyrin, and Eosin Y inhibited growth of hydrilla by about 30% at initial dye concentrations of 0.0001 M dye. Hematoporphyrin was most effective, based on the weight required to reduce growth. Methylene blue was adsorbed onto the plant, but the other two dyes were not adsorbed. A mechanism for growth inhibition was proposed: that the dyes intervene in photodynamics. That is, the dye generates large numbers of singlet oxygen molecules, which destroy carotenoids and other cellular quenchers. (Cassar-FRC)
W83-02336

ANNUAL AND MONTHLY RESERVOIR OPERATING RULES GENERATED BY DETERMINISTIC OPTIMIZATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. Karamouz, and M. H. Houck.
Water Resources Research, Vol 18, No 5, p 1337-1344, October, 1982. 2 Fig, 7 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Operating policies, *Streamflow, Reservoir releases, Water management, Optimization, *Algorithms, Benefits, Planning.

General reservoir system operating rules were developed by deterministic optimization. An algorithm which cycles through a deterministic dynamic program, a regression analysis, and a simulation model was described and tested for 48 cases. These included small to very large reservoirs, different streamflow characteristics, and annual or monthly time steps. Annual operating rules were determined for 12 cases (4 capacities at each of 3 single reservoir sites) and monthly operating rules for 36 cases (the same 4 capacities and 3 sites with different portions of the historical monthly streamflow records). At each iteration in the algorithm the reservoir releases became more constrained, refining the general operating rule. Data indicated that the first rule obtained was not the best rule in any case. Average loss reduction was 29.3%. Reservoir capacities of 20%, 50%, and 100% of mean annual flow reduced losses by 2.9%, 16.4%, and 39.5%, respectively. For 9 cases in which reservoir capacity exceeded mean annual flows, the average loss reduction obtained by refining operating rules was 58.5%. Selection of streamflow record sequence was also significant. Best results for different reservoirs were obtained from using different 15-year sequences. (Cassar-FRC)
W83-02344

REAL-TIME DAILY RESERVOIR OPERATION BY MATHEMATICAL PROGRAMMING,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. H. Houck.
Water Resources Research, Vol 18, No 5, p 1345-1351, October, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Cost-benefit analysis, *Reservoir operation, Model studies, Mathematical models, Streamflow, Reservoir storage, Planning, Objective function.

Mathematical programming models for real-time reservoir operation were evaluated, using two measures of quality: total value of actual penalties incurred by the operation and the closeness of model results to theoretical best results. Of the five models, each with different types of objectives, two were superior. One of these (Model B) requires trial and error fitting of a 6-parameter objective function. The other (Model C) has an objective function which is completely defined and needs no parameter fitting. Model C is useful where only a reference set of historical operations is known. It can also be used to predict a reservoir operation program for a new development (turbine, dam, recreation) for which no experience has been accumulated. This eliminates the costly, sometimes unreliable cost-benefit procedure. (Cassar-FRC)
W83-02356

UNIFORM FLOW OVER SKEW SIDE-WEIR,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. C. Jain, and E. E. Fischer.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 163-166, June, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Design criteria, *Drainage systems, *Mathematical studies, *Channel morphology, *Weirs, Irrigation ditches, *Mathematical models, Drainage engineering, Discharge measurement, Mathematical equations, Channels, Model studies, Theoretical analysis.

Side-weirs have been used extensively for diverting excess water from irrigation and drainage systems. A uniform discharge distribution over the side-weir can be obtained by a proper reduction in the width of the channel. A numerical solution was devised for the design of a side-weir with its crest oblique to the approach flow (skew side-weir) which would ensure an almost uniform discharge distribution from a rectangular channel over the skew side-weir. The theoretical results were verified in two experimental rectangular channels made from wood. Uniform discharge distributions over the side-weirs of both channels constructed in accordance with specified dimensions indicated good agreement with experimental and theoretical data. (Geiger-FRC)
W83-02400

THE USE OF A DISTRIBUTED CATCHMENT MODEL FOR THE EVALUATION OF DESIGN DISCHARGES IN THE URBAN ENVIRONMENT OF THE RIVER TAME, WEST MIDLANDS,
Severn-Trent Water Authority, Birmingham (England).
R. Wilkinson, and C. M. Simpson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 309-317, 1982. 5 Fig, 4 Ref.

Descriptors: *Hydrologic models, *Flood control, *Urban watersheds, Rainfall-runoff relationships,

Model studies, Urbanrunoff, Runoff, Design floods, Tame River, Flood Studies Report, Hydrographs, River flow, Channel storage, Channel flow, *England.

The lumped model approach given in the United Kingdom's Flood Studies Report (FSR) was compared with a distributed model based on the Hydraulic Research Station FLOUT routing procedure in design of the Upper and Middle Tame River Flood Alleviation Scheme. The FSR model was inappropriate for use in the large catchment where Channel translation processes were significant. It did not reflect the changes produced by simulating changes in channel restrictions, which were proposed as part of the flood alleviation scheme. The synthetic hydrograph peak was earlier and lower and the falling limb showed less runoff than the observed peak because of channel storage upstream. The distributed model clearly showed the effects of removing restrictions for a 100-year flood in the Lea Marston catchment. (Cassar-FRC)
W83-02401

TRAFFICABILITY FACTOR IN A SILTY CLAY LOAM SOIL,
Maine Univ. at Orono. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W83-02421

4B. Groundwater Management

ARTIFICIAL RECHARGE OF SURFACE RUNOFF IN COLD SPRING VALLEY, NEVADA,
Nevada Univ. System, Reno. Desert Research Inst.
J. E. Dowden, M. E. Campana, S. W. Wheatcraft, and R. L. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173229, Price codes: A04 in paper copy, A01 in microfiche. Publication No 41071, 1982. 50 p, 7 Tab, 9 Fig, 28 Ref. OWRT B-109-NEV(1), 14-34-0001-9082.

Descriptors: Groundwater, *Artificial recharge, Water salvage, *Aquifer model, Computer models, *Finite element model, Groundwater movement, Water harvesting, Infiltration, Infection, *Nevada, Cold Spring Valley, Runoff, Model studies.

Cold Spring Valley, Nevada was examined with the intent of developing a methodology for studying and implementing artificial recharge - surface runoff harvesting schemes that could be employed in other basins of Nevada. A steady-state, finite element model was used to simulate the Cold Spring Valley groundwater flow system. Calibration of the model along with limited field data suggests a hydrologic connection between Cold Spring and Upper Long Valley. Although the model only provides a steady-state approximation, the limited data base for most undeveloped areas in Nevada does not justify a more detailed analysis. For these areas, the model is considered suitable for similar applications. The primary limiting factor to any artificial recharge scenario in Cold Spring Valley is the response of the water table in the Reno Park subdivision caused by an increase in the septic field load. The existing groundwater and waste management practices mitigate against the implementation of artificial recharge in the valley at this time. In addition, difficulties are posed by the location of the optimum recharge site vis-a-vis the major surface runoff-producing area. However, with increasing growth in the valley, artificial recharge will undoubtedly become viable in the future.
W83-02131

CONJUNCTIVE MULTIBASIN MANAGEMENT: AN OPTIMAL CONTROL APPROACH,
California Univ., Davis. Dept. of Agricultural Economics.
J. E. Noel, and R. E. Howitt.
Water Resources Research, Vol 18, No 4, p 753-763, August, 1982. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Groundwater management, *Water supply, Management, *Irrigation, Model studies, *Economic factors, Interbasin transfers, Water transfer, *California, Yolo County district.

The economic effects of conjunctive management of ground and surface water supplies for irrigation are formulated as an optimal control model. An empirical hydroeconomic model is estimated for the Yolo County district in California. Two alternative solution methodologies (analytic Riccatti and mathematical programming) are applied and compared. Results indicate the economic potential for interbasin transfers and the impact of increased electricity prices on optimal groundwater management. The technique as presented has two important advantages over previous work done on optimal conjunctive water supply allocation. First, there is a direct interaction in the model between a complex hydrologic system and the demand for water. Second, the control model can be solved by several algorithms, two of which are demonstrated. (Baker-FRC)
W83-02162

DEWATERING OF AMBROSIA LAKE MINES,
Gulf Mineral Resources, Denver, CO.
H. C. Juvkam-Wold.
Mining Engineering, Vol 34, No 9, p 1344-1350, 1982. 7 Fig, 4 Ref.

Descriptors: *Aquifers, *Depressurization, *Wells, *Mines, *Dewatering, Aquifer characteristics, Water pressure, Grout curtain, Ambrosia Lake, *New Mexico.

The design of an aquifer depressurization system using wells is described. This particular system uses a number of wells surrounding a mine shaft to reduce the aquifer pressure in the vicinity of the shaft. The effect of various parameters such as number of wells, wellbore diameter, time, and well location is discussed. It is concluded that, with a properly designed depressurization system, the aquifer pressure and the water inflow rate to the shaft may be reduced to less than 15% of their potential values in the absence of wells. (Baker-FRC)
W83-02202

ESTIMATION OF GROUNDWATER RESOURCES ON THE BASIS OF DECISION-MAKING THEORY,
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
I. V. Zelenin, and V. I. Shumila.
Water Resources (English Translation), Vol 8, No 6, p 646-651, November/December, 1981. 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 6, p 134-140, November/December, 1981.

Descriptors: *Groundwater resources development, *Estimating, *Decision making, Theoretical analysis, Hydrogeomechanics, Mathematical equations.

An approach is proposed to assess the hydrogeological situation and predict its change corresponding most appropriately to the decision-making problem under conditions of considerable uncertainty of hydrogeological constructions and ever-increasing price of losses associated with prediction errors. Such a formation as is presented here is more realistic and economically more effective than the presently adopted deterministic representation of hydrogeological information. It is also constructive from the viewpoint of substantiating the types and extent of hydrogeological investigations for solving particular engineering problems. (Baker-FRC)
W83-02252

CONSERVATION IN LONG TERM CONJUNCTIVE USE: IRRIGATION DEMANDS USING DISAGGREGATE CHOICE MODELS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
B. C. Arntzen, D. H. Marks, J. L. Wilson, and R. Kryzystofowicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181792, Price codes: A15 in paper copy, A01 in microfiche. Final Report (in three sections), March 30, 1981. 324 p, 23 Fig, 18 Tab, 107 Ref, 4 Append. OWRT C-90119-C(No 9430)(1), 14-34-001-9430.

Descriptors: *Conjunctive use, *Irrigation water, *Model studies, *Economic aspects, *Water management, Water demand, Groundwater irrigation, Surface water, Policy making, Water table rise, Water resources development.

Because surface water and groundwater possess different temporal, spatial, and legal characteristics, it is often desirable to exploit these differences to improve water supply system performance. This report presents the hierarchy of sub-problems involved in modeling the demand for conjunctive use. An historical description of the development of conjunctive user irrigation and a review of current policy initiatives of local water management institutions support the contention that the prime determinants of the demand for new conjunctive use systems for irrigation are their profitability and local water policies. It appears doubtful that farmers actively seek new sources of water in order to exploit the different characteristics of the sources to optimize their efficiency. Surface water is often not available to present groundwater irrigators because of their distance from surface supplies and because most western streams have been fully appropriated for many years. The demand for new groundwater capacity by surface water irrigators has two very different causes: use of groundwater to lower a rising water table; and use of groundwater because surface water is scarce and unreliable. The possible future implementation of comprehensive water management policies needs to be explored by examining the institutional objectives of local water management agencies, and developing a predictive model of the acceptance of conjunctive use policies by irrigators. (Moore-SRC)
W83-02320

STOCHASTIC ESTIMATION OF STATES IN UNCONFINED AQUIFERS SUBJECT TO ARTIFICIAL RECHARGE,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
K. D. Schmidtke, E. A. McBean, and J. F. Sykes.
Water Resources Research, Vol 18, No 5, p 1519-1530, October, 1982. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Stochastic process, *Artifical recharge, *Unconfined aquifers, Aquifers, Estimating, Mathematical studies, Recharge, *Ontario.

An extended Kalman filter model for characterizing minimum variance estimates of the piezometric heads and coefficients defining an unconfined aquifer subject to artificial recharge is developed. The system evolution model employs Hantush's characterization. Sensitivity analyses were used to test the estimation capability of the technique. The ability of the extended Kalman filter to use all available information from both the system model and measurements of the state to provide approximate minimum variance estimates of the state and confidence limits is shown. The extended Kalman fitler version of Hantush's model is applied to a record data length of one year obtained at the study area located in Norwood, Ontario. The results of the study indicate that the meteorological conditions influence the water table elevations to a greater extent than the particular rate of recharge employed. Observation of the measured values indicates that greater recharge rates could be employed during the summer months, when rainfall is low and evapotranspiration is high, and lower recharge rates during the winter months to prevent the water table from inundating the weeping tiles. (Baker-FRC)
W83-02351

ADAPTIVE EXPLICIT-IMPLICIT QUASI THREE-DIMENSIONAL FINITE ELEMENT MODEL OF FLOW AND SUBSIDENCE IN MULTIAQUIFER SYSTEMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 2F.
W83-02352

AN INVESTIGATION OF THERMAL IMPACTS ON A SHALLOW AQUIFER FROM RECHARGE OF A GROUNDWATER HEAT PUMP SYSTEM,
North Dakota Univ., Grand Forks. Engineering Experiment Station.
D. W. Majkrzak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182063, Price codes: A04 in paper copy, A01 in michrofiche. North Dakota Water Resources Research Institute Completion Report, ND State Univ., Fargo, January 1982. 54 p, 43 Fig, 1 Append. OWRT A-069-NDAK(1), 14-34-0001-0136.

Descriptors: *Thermal pollution, *Groundwater, *Recharge, *Heat pump, Temperature, Reinjection, Thermocline, Thermal power, Heated water, Heat exchanger, Geothermal study, Seasonal, *Thermal gradients.

The site for monitoring thermal gradients experienced around the recharge well of a residential groundwater heat pump is located at Northwood, North Dakota (Figure 1). Ten test wells were drilled, surrounding the reinjection points, to monitor thermal gradients experienced in the vicinity of the recharge. Temperatures were recorded at 20 and 25 foot depths, corresponding to the top and bottom of the active section of the recharge casing with data collected every two weeks, beginning in November 1980 and continuing through December 1981. Well temperatures were also confirmed, using a thermocouple attached to a long probe. Examination of the test results indicated during heating that the discharge water had saturated the test area at a constant water temperature. The transition from heating to cooling was apparent in the data collected during the month of June and back to partial heating in October. Accurate thermal maps were developed during these periods. During the month of December 1981, two new test wells were installed at the site, which were evenly spaced toward the supply well. This site will be maintained and data collection continued through the 1982 calendar year at the University of North Dakota's own expense.
W83-02364

INVESTIGATION OF COUPLED SIMULATION METHODS FOR NORTH DAKOTA SPACE HEATING-COOLING SCENARIOS USING GROUNDWATER,
North Dakota State Univ., Fargo. Dept. of Mechanical Engineering.
H. R. Busby, and W. G. Rieder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182071, Price codes: A07 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion report, August, 1982. 32 p, 2 Fig, 1 Tab, 46 Ref, 2 Append. OWRT A-071-NDAK(1), 14-34-0001-1136.

Descriptors: Aquifer, Heat transfer, Heat exchanger, *Simulation, *Aquifer management, *North Dakota, Groundwater, Algorithms, *Codes.

An investigation of thermal-reservoir simulation methods was aimed at finding a package which would be locally appropriate for shallow aquifers and coupled above-grade space heating-cooling systems. A combination of information solicitations, algorithm tests, literature surveys, and existing code reviews showed that most available codes were overly sophisticated relative to the original constraints established for local use. Available codes also tended to have common shortcomings in treating temperature-dispersion, thermal property-uncertainty, and buoyancy effects. As a consequence several small, streamlined, simulator codes were set up by using composites of existing programs; and validation tests were started. Both finite element and finite difference (Marker cell) methodologies were incorporated. From these the one having fewest limitations, a two-dimensional (pseudo three dimensional) marker-cell simulator, is presented along with a description of use limitations.
W83-02365

USE OF PROTOTYPE MODELING FOR ESTIMATING NATURAL GROUNDWATER RESOURCES,
Akademiya Nauk URSR, Kiev. Inst. Geologichnykh Nauk.
For primary bibliographic entry see Field 2F.
W83-02418

GROUNDWATER REGIME IN ZONES OF OPERATING ARTIFICIAL RECHARGE SYSTEMS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
A. S. Chernov.
Water Resources (English Translation), Vol 8, No 6, p 637-642, November/December, 1981. 3 Fig, 2 Ref. Translated from Vodnye Resursy, No 6, p 120-128, November/December, 1981.

Descriptors: *Groundwater management, *Aquifer recharge, Artificial recharge, *USSR, Water supply, Water resources development, Infiltration, River basins, Caucasus.

Artificial groundwater recharge has been carried out by means of infiltration basin in the Caucasus since 1958. Regime observations were organized in 1977 to study the natural groundwater regime groundwater and its transformation in the area of the intake works under the effect of artificial recharge and long operation of the intake, to analyze the regime of surface waters, to refine the adopted technological scheme of artificial groundwater recharge, to refine the optimal operating regime of the infiltration works, and to analyze the experience of artificial formation of groundwaters under conditions of mountain-type river valleys. The study identified two types of groundwater regimes - natural and disturbed. The main factor forming the natural regime of near-channel groundwaters is the river hydrology. The disturbed regime is mostly affected by operation of the intake and artificial infiltration from the basins. Meteorological factors of precipitation and evaporation play only a secondary role except during basin cleaning. An important characteristic of the regime of groundwater level in the zone studied is its highly dynamic character and the considerable range of variations on comparatively small areas near the basins and river. It is advisable to regenerate the infiltration basins twice a year in the fall and spring, when the necessary capacity of the intakes can be provided due to seepage from the river without artificial recharge. The mineral content of the groundwaters was slightly higher than that of surface waters and was mostly in the form of calcium carbonate. Deterioration of the physical-chemical and bacteriological properties of the groundwaters was not observed. (Baker-FRC)
W83-02446

4C. Effects On Water Of Man's Non-Water Activities

FACTORS INVOLVED IN EVALUATING GROUND WATER IMPACTS OF DEEP COAL MINE DRAINAGE,
Geraghty and Miller, Inc., Champaign, IL.
P. R. Davis, and W. C. Walton.
Water Resources Bulletin, Vol 18, No 5, p 841-848, October, 1982. 11 Fig, 7 Tab, 6 Ref.

Descriptors: *Drawdown, *Coal mines, *Mine drainage, Permeability, Aquifers, Storage capacity, Model studies, Groundwater level, Wells, Transmissivity, Drainage, Pumping tests, Well data, *Indiana, Water quality.

Methods for evaluation of groundwater impacts of proposed deep coal mine drainage are illustrated, using the example of a proposed mine in southwestern Indiana. The coal seam considered for mining is the Indiana V seam, which lies in a thick sequence of sandstone, shale, limestone, and coal units. Data were obtained from three production wells in the area. Drawdowns in aquifers were determined by modeling a 5-year plan for mining as follows: Year 1, construct a 20 ft diameter mine shaft through sand and gravel; Year 2, advance shaft through bedrock to coal seam, Years 3-5, develop 600 ft wide mine drifts according to plan. Estimated drawdown after 5 years was: in bedrock, 400 ft in the immediate vicinity of the mine drifts to 1 ft at 1/2 mile away; in gravel and sand, 0.5 ft near the center of mine drifts to 0.25 ft at 100 ft distant. The increase in recharge and decrease in evapotranspiration would produce a very small net change in groundwater budget. Gathering data from production wells is often complicated by low permeabilities of rock in coal seam systems, low pumping rates, limited cones of depression, long required pumping periods, and the effects of well storage capacity. Simulation of coal mine drainage involves horizontal permeabilities and storage coefficient of the coal seam zone, vertical permeabilities of the aquitard above and below the coal seam zone, and the hydrologic properties of the source bed above the aquitard overlying the coal seam zone. The groundwater level declines in coal seam zone and source bed near the land surface must also be considered in impact analysis. (Cassar-FRC)
W83-02149

EFFECTS OF URBANIZATION ON BASE FLOW OF SELECTED SOUTH-SHORE STREAMS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
D. L. Simmons, and R. J. Reynolds.
Water Resources Bulletin, Vol 18, No 5, p 797-805, October, 1982. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Base flow, *Urbanization, *Sewer systems, Streamflow, Low flow, Long Island, *New York, Storm runoff, Storm sewers, Water table aquifers, Recharge, Groundwater recharge.

Hydrographs of six gaged streams on Long Island's south shore were analyzed to assess the effects of urbanization on streamflow. The mean base flow components of total annual streamflows, based on data from 1948 to 1970, were: urbanized sewered area in southwestern Nassau County, 45-61%; urbanized unsewered area in southeastern Nassau County, 86-88%; and a rural unsewered area, 96%. From 1948 to 1970 the base flow component remained constant in the rural streams; decreased from 95% to 20% (sometimes as low as zero in some years) in the urbanized sewered area; and decreased from 95% to about 84% in the urbanized unsewered area. Double mass curve analysis indicated that the changes in streamflow began in the early 1960's in the sewered area and in the late 1960's in the urbanized unsewered area. Causes of the reductions in base flow were discharge of treated effluents to tidewater, routing of storm runoff directly to streams through storm sewers, and decrease in precipitation infiltration because of decreased permeable area. (Cassar-FRC)
W83-02170

FOG DRIP IN THE BULL RUN MUNICIPAL WATERSHED, OREGON,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
R. D. Harr.
Water Resources Bulletin, Vol 18, No 5, p 785-789, October, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Fog, *Precipitation, *Logging, Interception, Streamflow, Clear-cutting, Forest management, *Forest watersheds, Fox Creek, Bull Run Watershed, Portland, *Oregon, Vegetation effects, Trees, Rain gages, Gaging, Condensation, Soil-water-plant relationships, Watersheds, Douglas fir.

Net precipitation (gross precipitation plus fog drip minus interception loss) under old growth Douglas fir forest in the Bull Run Municipal watershed, Portland, Oregon, was 1739 mm during a 40 week snow-free period. This was 387 mm more than in adjacent clear-cut areas. Calculations determined

that fog drip could have added 882 mm of water during a year, based on 2160 mm of rain measured in a nearby clearing. Implication of these findings are: rain gages installed in open areas where fog is common may collect up to 30% less precipitation than in a forest, and timber harvesting may reduce annual water yield and summer streamflow. (Cassar-FRC)
W83-02173

EVALUATION OF THE REDUCTION OF THE VOLUME OF FLOW CARRIED BY CERTAIN RIVERS OF PUERTO RICO AND ITS POSSIBLE CORRELATION WITH CHANGES IN LAND USE, FROM 1508 TO PRESENT,
Puerto Rico Univ., Mayaguez. Dept. of General Engineering.
For primary bibliographic entry see Field 2E.
W83-02215

4D. Watershed Protection

IMPROVING WATERSHED-MODEL ACCURACY BY USING DIGITAL TOPOGRAPHY,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 2A.
W83-02233

CALCULATION OF THE RUNOFF-REGULATING EFFECTIVENESS OF FOREST BELTS,
All-Union Scientific Research Inst. of Soil Erosion Control, Kursk (USSR).
A. Kh. Alibekov, and V. S. Burumenskii.
Water Resources (English Translation), Vol 8, No 6, p 597-603, November/December, 1981. 2 Fig, 5 Ref. Translated from Vodnye Resursy, No 4, p 62-69, November/December, 1981.

Descriptors: *Rainfall-runoff relationships, *Erosion control, *Forests, Mathematical equations, Absorption, Snowmelt, Runoff, Rainfall, Erosion.

In connection with the fact that water-regulating forest belts comprise one of the elements of a complex of erosion-control measures accomplished on slopes, an estimate of their runoff-regulating ability is needed first of all for calculating the residual runoff. A quantitative estimation of the effect of the age of the forest and location of the forest belts on the slope acquires considerable importance, along with the well-known factors determining the water absorbing ability of soils within the forest belt. In this case it is possible to estimate that part of the runoff which is absorbed by the forest belts from the slope. In one of the possible variants of the solution a formula is proposed which makes it possible with some degree of approximation to calculate the amount of reduction of the overland runoff under the effect of forest belts, but does not take into account such important indices as their age and location on the slope. This problem can be solved if the water absorption within the forest belt during the period of the spring or storm runoff is known. Such water regulating forest belts which can absorb both the water equivalent of snow and the runoff arriving from above are considered in the calculations presented in this paper. For these calculations it is assumed that the width of the forest belt is small compared to the distance between the watershed and the forest belts or only between the forest belts. Only the distances to the lower borders of the forest belts are introduced into the calculation scheme. (Baker-FRC)
W83-02238

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

THE APPLICATION OF A LASER INTRACAVITY ABSORPTION DETECTOR TO GAS CHROMATOGRAPHY OF TRACE ORGANIC POLLUTANTS IN WATER,
Arkansas Water Resources Research Center, Fayetteville.
R. B. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173195, Price codes: A03 in paper copy, A01 in microfiche. Publication No 89, December 19282. 24 p, 3 Fig, 2 Tab. OWRT B-066-ARK(1), 14-34-0001-1205.

Descriptors: Organic wastes, *Lasers, *Gas chromatography, Trace levels, *Pollutant identification, *Water analysis, Analytical techniques, *Trace organics, Infrared, *Laser intracavity absorption detector.

A helium-neon (HeNe) laser operating simultaneously at 3.39 um (infrared) and 0.63 um (visible) has been used as a selective detector for hydrocarbons in the effluent of a gas chromatography. The infrared and visible laser transitions originate at the same energy level and are competitive. When a hydrocarbon enters the laser's resonant cavity, the 3.39 um is absorbed due to the C-H stretching vibration and the visible emission is enhanced. The visible laser emission is monitored with a photodiode as a quantitative measure of the concentration of the absorbing molecule. The minimum detectable concentration for propane using the double-beam configuration is 20 pg/mL, which is 25 times lower than the best value reported for a thermal conductivity detector. In practice, the detector's selectivity for hydrocarbons is modified by various substituents. The detector responds to aliphatic and aromatic hydrocarbons with aliphatic side chains, except for those substituted with halogens. The NeHe laser intracavity absorption detector may be used without prior separation in some cases (e.g., methane in coal mines). This detector operates with nitrogen carrier gas without sacrifice of sensitivity and should be useful for monitoring organic pollutants since it does not respond to water or carbon dioxide. Also, it should be possible to manufacture this detector at competitive prices.
W83-02128

TOTAL OXYGEN DEMAND--RECENT ADVANCES IN THE AUTOMATIC OXYGEN DEMAND ANALYSIS TECHNIQUE,
Ionics, Inc., Watertown, MA.
D. E. Lueck, R. A. Dishman, and R. B. Thayer.
ISA Transactions, Vol 20, No 2, p 67-76, 1981. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Oxygen demand, *Organic compounds, *Pollutant identification, *Total oxygen demand, Water analysis, *Biochemical oxygen demand, *Chemical oxygen demand, Organic carbon, Automation, Monitoring.

Total oxygen demand (TOD) analysis has proved faster, more accurate, and less subject to interferences than BOD and COD analyses. TOD more accurately reflects the oxygen demand impact of organic pollutants on receiving waters than total organic carbon determination. TOD is unaffected by inorganic carbon. It measures oxygen consumption and reflects the oxidation state of the organic carbon. TOD analysis also indicates noncarbonaceous materials that consume or contribute oxygen (ammonia, sulfite, sulfides). Interferences in TOD analysis are nitrate and acidic sulfate, which produce low readings, and dissolved oxygen at low-range measurements. The goals of recent improvements on the TOD method include operation below 50 ppm TOD, elimination of salt interferences, and solving of problems in combustion which produced poor results. The present models of equipment, Ionics Model 1248 laboratory TOD analyzer and Ionics Model 1270M Combination TOD/TOC analyzer, have solved previous problems and feature improved, automatic, reliable, high sensitivity determinations. (Cassar-FRC)
W83-02195

BIOLOGICAL INDICATION OF WATER QUALITY: THE GEOGRAPHIC ASPECT,
All-Union Scientific-Industrial Association of the Pulp and Paper Industry, Moscow (USSR).
V. A. Alekseev.
Water Resources (English Translation), Vol 9, No 1, p 92-98, January/February, 1982. 1 Tab, 7 Ref. Translated from Vodnye Resursy, No 1, p 140-146, January/February, 1982.

Descriptors: Water quality, *Bioindicators, *Monitoring, *Biomonitoring, *Insects, *USSR, Water quality control, Water pollution control, Pollutant identification.

A method for biomonitoring is proposed. This method is based on the bioassay, that is, on an acute, brief experiment, although it involves a more complex organization, stringent standardization, and unification with respect to many components. The comparative toxic substance resistance of a large group of aquatic macroinvertebrates-insects and arachnids - was investigated in 1970 at the facilities of the Institute of Biology of Inland Waters, Academy of Sciences of the USSR. Insects were represented by 46 species, mainly larvae of caddisflies, mayflies, stoneflies, beetles, dragonflies, dipterans, alderflies, butterflies, and also the imagoes of bugs and beetles. The results obtained made it possible to establish a distinct regularity of resistance of the investigated animals to the effect of the toxicant. At the same time the order of resistance of the organisms to phenol was not a reflection of the specific effect of the model toxicant alone, but was characteristic with respect to the effect of the majority of toxicants of the most diverse origin. The established regularity of resistance of hydrobionts to toxic action is the basis for creating a unified indicator system at the level of macroorganisms. However, composed of organisms of only one geographic zone, the system will be complete only on broadening comparative toxicological investigations conducted by a single unified method in various geographic regions of the country. (Baker-FRC)
W83-02236

GAS CHROMATOGRAPHIC ANALYSIS OF HALOCARBONS IN DRINKING WATER BY HEADSPACE EXTRACTION AND MIXED COLUMN SEPARATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
G. Castello, T. C. Gerbino, and S. Kanitz.
Journal of Chromatography, Vol 247, No 2, p 263-272, 1982. 3 Fig, 4 Tab, 35 Ref.

Descriptors: *Chlorinated hydrocarbons, *Water analysis, *Gas chromatography, *Trihalomethanes, Chlorination, *Pollutant identification, Drinking water, Organic compounds.

Trihalomethanes formed by chlorination during water treatment were completely resolved by gas chromatographic analysis using a series arrangement of polar and nonpolar liquid stationary phases. These were SP-100 (polar polyethylene glycol Carbowax 20M plus terephthalic acid) and OV-101 (nonpolar methylsilicone). Liquids were applied at 10% concentrations on 80-100 mesh Chromosorb W DMCS. A headspace extraction technique and a Ni63 electron-capture detector were used for quantitation. The compounds separated were those produced by chlorination of natural water (chloroform, dichlorobromomethane, dibromochloromethane, and bromoform) and common industrial solvents (1,1-dichloroethylene, methylene chloride, 1,1-dichloroethane, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, and tetrachloroethylene). Mixed columns (both phases on the same column) required complex preparation methods and had lower resolving powers. With proper temperature programming of the column, an analysis can be completed within 30 min. There are no interferences with the common extraction solvents, n-pentane, n-hexane, and isooctane. (Cassar-FRC)
W83-02284

ANALYSIS OF INORGANIC ANIONS IN THE POTOMAC WATER SEDIMENT AND FLOC BY ION CHROMATOGRAPHY,
American Univ., Washington, DC. Dept. of Chemistry.
J. E. Girad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-180299,

Price codes: A03 in paper copy, A01 in microfiche. D. C. Water Resources Research Center Report No 37, Univ. of the District of Columbia, May 1982. 33 p, 4 Tab, 8 Ref, 12 Fig. OWRT A-011-DC(1), 14-34-0001-1109.

Descriptors: *Municipal water, *Sediment, *Floc, Electrical conductance, Polivalent anions, Ionic concentration, *Ion chromatography, Analytical chemistry, *Pollutant identification, Potomac River, District of Columbia.

Recent reports by the authors have shown non-suppressed ion chromatography, which uses conventional high pressure liquid chromatography (HPLC) instrumentation, to be a low cost analytical technique for the analysis of inorganic anions. A Varian Model 5000 HPLC was coupled with a Wescan Conductivity Dectector. All separations were achieved on a Vydac 302 IC Column at a controlled temperature of 30C. This system is designed to work without a suppressor column, thus achieving better chromatographic efficiency and saving time in regenerating the suppressor column. Very efficient separations of anions such as Cl super -, NO sub 3 super -, and SO sub 4 super -2 are easily achieved with this system. The sensitivity we have observed for Cl super - ions (0.5 PPM) is comparable to conventional supressed IC. Sensitivity for nitrate (1.25 PPM) and sulfate (1.25 PPM) is only slightly less than that which is observed for the conventional supressed IC method. Linearity is very good over a wide concentration range. By changing the eluting species, its concentration or the pH, improved sensitivity, chromatographic efficiency, selectivity and resolution may be achieved. This technique has been successfully applied to the analysis of municipal water samples from Howard, Baltimore and Montgomery Counties in Maryland, as well as the District of Columbia. Samples of Potomac River water taken at the Chesapeake Bay/Potomac River interface are usually very difficult to analyze, since there is a small amount (10-15 PPM) of Chloride ion. Potomac River samples were also successfully analyzed.
W83-02292

DETERMINATION OF NITRITE AND NITRATE IN WATER BY REDUCTION TO AMMONIA FOLLOWED BY ENZYMATIC CYCLING,
American Univ., Washington, DC. Dept. of Chemistry.
F. W. Carson, and P. L. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180331, Price codes; A03 in paper copy, A01 in microfiche. D. C. Water Resources Research Center Report No 42, Univ. of the District of Columbia, September 1982. 28 p, 2 Fig, 2 Tab, 16 Ref. OWRT A-019-DC(1), 14-34-0001-2109.

Descriptors: *Nitrate, *Nitrite, *Ammonia, *Enzymatic cycling, *Assay, Analysis, Colorimetic, Amonium chloride, Absorbance linear regression analysis, Hydrochloric acid, Reduction, Spectorphotometry, Interferences, *Pollutant identification.

A procedure has been developed to determine the concentration of biologically significant nitrogen present as ammonia, nitrite and nitrate in water samples colorimetrically. In addition, the concentration of each of these constituents may be determined separately if desired. The method is sensitive and not subject to the interferences commonly encountered in nitrate determinations. It involves the reduction of nitrite and/or nitrate to ammonia with Devarda's metal while simultaneously trapping the released gaseous ammonia with dilute hydrochloric acid solution in a modified Conway diffusion cell. Subsequently, the ammonia is determined using the enzymatic cycling assay previously developed by Carson and Davies. Standard solutions of ammonium chloride must be carried through the procedure to prepare a standard curve from which unknown concentrations of nitrate may be determined. Using the established procedure, plots of Absorbance change at 600 nm versus original nitrate concentration wre linear, with correlation cofficients ranging from 0.991 to 0.999. A series of replicate measurements had a coefficient of variation of 3% for samples containing 2.70 x 10 super -5 M nitrate ion when compared to such a standard curve.
W83-02296

CHARACTERISTICS OF MUNICIPAL WASTEWATERS,
Southern California Coastal Water Research Project Authority, Long Beach.
H. A. Schafer.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p 11-16, 1 Fig, 5 Tab.

Descriptors: *Pollutants, *Municial wastewater, *Suspended solids, *DDT, *Heavy metals, Effluents, Chlorinated hydrocarbons, Trace metals, Flow, arsenic, Cadmium, Chromium, Coper, Lead, Mercury, Nickel, Selenium, Silver, Zinc.

Municipal wastewaters account for most of the pollutants entering southern California's coastal waters. During 1980 and 1981 the flow from the largest ocean dischargers averaged 1,094 million gallons per day (4.1 billion liters/day) and contained 610 metric tons of suspended solids. Data are presented showing the average annual concentration and calculated mass emissions of some constituents from 1971-1981, and the trends of five constituents for the past 11 years. During the last two years, discharge trends relative to general constituents showed that the flow is 40 mgd higher than the previous high, with Orange County having over half the increase, that BOD5 is the highest since 1971, and that suspended solids are the lowest in 11 years. BOD is usually less than suspended solids but has been greater in the past four years, reflecting the importance of dissolved BOD, or the higher demand of the remaining suspended solids. Of ten metals measured, seven were at the lowest reported levels since reporting began. Arsenic and selenium, discharged in small amounts, show no consistent trend. Silver decreased in 1980 and 1981 after increasing during the past four years. Relative to chlorinated hydrocarbons, DDT continues to decrease 20-30% per year with total output being less than 500 kg. for the first time. PCBS have not dropped much since 1979 and remain about 1,200 kg. per year, although PCBs are distributed more evenly than DDT. (Atkins-Omniplan)
W83-02301

SEAWATER AND WASTEWATER TOXICITY STUDIES,
Southern California Coastal Water Research Project Authority, Long Beach.
P. S. Oshida, S. M. Bay, A. Haeckl, K. Goochey, and D. Greenstein.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 39-44, 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Municipal wastewater, *Wastewater disposal, *Toxicity, *Bioassay, *Water sampling, Ocean disposal, Echinoderms, Outfall, Morphology, Fertilization, Larvae, Effluents, Water treatment facilities.

To set meaningful discharge criteria for municipal wastewater disposal, a new bioassay based on echinochrome systhesis by larval sea urchins has been used. The goals of this project were to evaluate the bioassay's ability to detect toxicity in complex seawater and wastewater samples and to estimate the range of toxicity present in harbor and offshore areas. The bioassay was conducted with seawater from harbor and offshore stations, seawater from near an outfall and wastewater effluents from five treatment plants. Monthly samples of offshore and harbor waters were tested for toxicity using three bioassay methods: echinochrome production, 15-minute fertilization production, and 48-hour developmental morphology. Using these methods, the samples showed only sporadic toxicity over a 14-month period; the specific compounds causing the toxicity were not determined but could have been in response to natural toxins. The echinochrome and development tests appeared more sensitive to toxicity than the 15-minute test. After testing the three methods on different water samples, the echninochrome test was shown to be faster, simpler, more reliable, and therefore, the best bioassay for general use. This procedure requires only 25% of the time needed for the development test and requires less technical and biological expertise. The echinochrome bioassay is a convenient way of detecting toxicity and appears more sensitive than the other two methods. It is also sensitive to concentrations of about 1% which is about equal to the levels at the edge of each outfall's initial dilution zone, and thus, a useful indicator of possible toxicity outside the zone of dilution. (Atkins-Omniplan)
W83-02306

METALS IN SURFACE SEDIMENTS FROM POINT DUME TO POINT HUENEME,
Southern California Coastal Water Research Project Authority, Long Beach.
G. P. Hershelman, P. Szalay, and C. Ward.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p 259-265, 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Trace metals, *Volatile solids, *Particle size, *Water depth, *Sediments, Outfalls, Sampling, Settling velocity, Sediment distribution, Correlation coefficients, Cadmium, Chromium, Copper, Lead, Nickel, Silver, Zinc.

During 1980, the Coastal Water Research Project added 73 stations to its survey of the coastal shelf and slope of southern California. Prior surveys off the Palos Verdes Peninsula and Santa Monica Bay found highly elevated metal concentrations in surface sediments. This report provides the measurements of seven trace metals and four physical parameters, such as water depth, total volatile solids, and percent solids, in a region where the Infaunal Index indicates normal conditions exist. Concentrations of silver, cadmium, chromium, copper nickel, lead and zinc are presented. Only a single measurement per station for each parameter was made, however, there was a high correlation of trace metal concentrations with the physical components of the sediments. In deeper water, the sediments are composed of smaller particles, therefore, trace metal concentrations increase with depth. Total volatile solids (TVS) also correlate positively with increasing water depth because of the adsorptive qualities of finer grain size. Therefore, trace metal concentrations also correlate with TVS, and some portion may be attached to the volatile solids. Percent solids yield high (negative) correlation coefficients with metals because low percent solids reflect more water content which occurs with fine grain size sediment. Lead yielded the lowest correlation coefficient with water depth. In general, trace metals fall within control values and correlate positively with water depth, TVS, and smaller particle size fractions of the sediments. There was a negative correlation between metals and the dry to wet weight ratio of the sediments. (Atkins-Omniplan)
W83-02309

USEFULNESS OF THE SELF-FERTILIZING CYPRINODONTID FISH, RIVULUS MARMORATUS AS AN EXPERIMENTAL ANIMAL IN STUDIES INVOLVING CARCINOGENESIS, TERATOGENESIS AND MUTAGENESIS,
Charleston Coll., SC. Grice Marine Biological Lab.
C. C. Koenig, D. C. Abel, C. W. Klingensmith, and M. B. Maddock.
Environmental Protection Agency Project Summary EPA-600/S3-82-075, September 1982. 5 p, 2 Fig, 3 Tab.

Descriptors: *Bioassay, Monitoring, Water quality, Toxicity, Fish behavior, *Carcinogens, *Mutagens, *Teratogens, Larvae, *Caribbean region, *Biomonitoring, *Pollutant identification.

Rivulus marmoratus is a naturally self-fertilizing cyprinodontid fish inhabiting mangrove throughout the Caribbean. As a result of internal self-fertilization, this oviparous species is composed of a number of isogenic, homozygous lines (clones), several of which have been identified by histocompatibility tests and maintained in laboratory culture

for over 30 years. Simplified culture and handling methods are given and data are presented on the reproduction, growth and development of rivulus under laboratory culture. Several types of bioassays were run and evaluated using rivulus; behavioral, carcinogenic, teratogenic, toxic, and mutagenic. Behaviorally, rivulus is capable of detecting and avoiding water contaminated with hydrogen sulfide. They respond by leaping from the water and remaining emergent for various periods of time while respiring cutaneously. Rivulus shows promise in water quality management as a test animal for biological monitoring. The behavior is easily quantified, the response is rapid, and normal variations in environmental parameters do not elicit the response. Hepatocellular carcinoma, among the pathological changes, was observed in livers of rivulus a year after exposure of adults and larvae to diethylnitrosamine. High rates of various skeletal malformations were found in offspring of adults exposed to dibutyl phtalate and 2,3,4,6,-tetrachlorophenol. Because of the many attributes of rivulus, including genetic uniformity of clones, it is anticipated that further development of this assay would produce a powerful tool useful in water quality management. (Moore-SRC)
W83-02313

DETECTION OF IODINE SPECIES IN DILUTE AQUEOUS SOLUTIONS AND THE MODIFICATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF IODIDE SALTS WITH MACROCYCLIC MULTIDENTATE LIGANDS,
Georgia Inst. of Tech., Atlanta. Dept. of Chemistry.
C. L. Liotta, R. C. McFarland, and M. B. Bruce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182030, Price codes: A02 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 11-82, November 1982. 23 p, 5 Tab, 17 Ref. OWRT A-074-GA(1), 14-34-0001-8011.

Descriptors: *Anion exchange, Anion exchange resins, *Aqueous solutions, Chromatography, Gas-liquid chromatography, Indicators, *Iodine species, *Iodocatechol, Macrocyclic multidentate, *Ligands, Mass spectrometry, Metal ion salts, Organo-iodine product, Organic molecules, Quantitative methods, Radiation degradation, *Solvent extractions, *Spectrometry, Starch indicators, *Pollutant identification.

Quantitative methods for the detection and determination of the following iodine species in dilute aqueous solution have been explored: I super -, I sub 2, I sub 3 super -, HOI, HIO sub 3 and HIO sub 4. Qualitative procedures for the detection of I sub 2 and I sub 3 (starch indicator method, organic solvent extraction method, and I sub 3 super - chromophore method) were employed to determine if reaction took place between the above iodine species (I super -, I sub 2, I sub 3 super -, HIO, HIO sub 3 and HIO sub 4) and a variety of organic molecules (phenols, glycols and related structures, amino acids, aromatic acids, aromatic chlorides) under dilute aqueous conditions. In a few cases (catechol and p-hydroxybenzoic acid) the organo-iodine product was synthesized by an alternate route and compared with the reaction sample by gas-liquid chromatography and mass spectrometry. Reaction of inorganic iodine with catechol was studied in the absence and presence of gamma radiation. Iodocatechol was identified as the product in the former case but no identifiable organic products were produced in the latter. The primary source or organic material in power reactor primary coolant systems is radiation degradation of the organic cation and anion exchange resins. The primary gaseous products identified from this decomposition are methane, ethane and propane. Complexes of metal ion salts of I sub 3 super -, I sub 2 Br super - and I super - with macrocyclic multidentate ligands were prepared. In addition, the reactivity of iodide ion in these complexes with a variety of alkylhalides was investigated in non-polar (benzene) and dysolar, aprotic (acetonitrile) solvents.
W83-02360

ANALYZING ASBESTOS FIBERS IN WATER BY MEANS OF TRANSMISSION ELECTRON MICROSCOPY,
Washington Univ., Seattle. School of Public Health and Community Medicine.
E. S. Boatman.
Journal of the American Water Works Association, Vol 74, No 10, p 533-536, October, 1982. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Asbestos, *Electron microscopy, *Pollutant identification, Drinking water, Water analysis, Fibers, Sample preparation, Turbidity, Water treatment.

A transmission electron microscopy method for determining asbestos fibers in drinking water is described in detail. This procedure requires special facilities, extensive manipulations, and excellent laboratory technique. Sample collection should include a history of the water source (meteorological conditions, presence of asbestos-cement pipe, etc.). Sample preparation and analysis should be done in an ultraclean room with a laminar flow biohazard cabinet, a highly efficient water still or filtration-ion exchange system, a suitable transmission electron microscope, vacuum evaporator, low temperature asher, and membrane filters. Procedures for sample filtration, counting, and identification are given. Asbestos fibers have parallel sides, a length to width ratio of $>$ 3:1, and a distinctive morphology and crystalline structure. They may be classified as chrysotile, amphibole, ambiguous, or nonasbestiform. Fiber counts are recorded in millions of fibers per liter of water (MFL), knowing the average area for a filter grid square, the volume of water filtered and the fiber count. A suitable fiber distribution for accurate results is 5-100 fibers per 30 grid squares. In general, water flowing in asbestos-cement pipes has a large proportion of fibers with lengths $>$ 1.0 microns, with a mean length of 4.5 microns and a maximum length of 80 microns. (Cassar-FRC)
W83-02382

COMPARISON OF SEVERAL INSTRUMENTAL METHODS FOR DETERMINING CHLORINE RESIDUALS IN DRINKING WATER,
Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, M. F. Mehran, R. A. Slifker, D. A. Smith, and J. T. Villate.
Journal of the American Water Works Association, Vol 74, No 10, p 546-552, October, 1982. 12 Tab, 25 Ref.

Descriptors: *Chlorine, *Water analysis, *Residual chlorine, *Pollutant identification, Drinking water, Amperometric titration, Electrodes, Membrane electrodes, Statistical analysis, Potentiometric electrodes, *Measuring instruments, *Water treatment.

Four methods for determining chlorine residuals in water were evaluated: two membrane electrodes, a potentiometric electrode, and a continuous total chlorine analyzer. Amperometric titration was used as a referee method. Two types of water samples were analyzed, quality assurance samples from the U.S. EPA and tap water. Results of analysis by the four methods were compared statistically for the quality assurance samples and for total chlorine in tap water. The total chlorine analyzer produced the best precision for individual analysts. Precision of all analysts was best with the total chlorine analyzer, followed by the amperometric titration, then the potentiometric electrode. (Cassar-FRC)
W83-02383

A NOTE ON THE ISOLATION AND ENUMERATION OF GRAM POSITIVE COCCI FROM MARINE AND ESTUARINE WATERS,
Maryland Univ., Baltimore. Dept. of Microbiology.
B. A. Gunn, F. L. Singleton, E. R. Peele, and R. R. Colwell.
Journal of Applied Bacteriology, Vol 53, No 1, p 127-129, 1982. 2 Tab, 10 Ref.

Descriptors: *Bacteria, *Saline water, *Pollutant identification, Estuaries, Seawater, Staphylococcus, Micrococcus, Streptococcus, Heterotrophic bacteria, *Gram positive bacteria, *Cocci, Chesapeake Bay, Narragansett Bay, Atlantic Ocean, Puerto Rico Trench dump site, Data collections.

Gram positive cocci counts (per 100 ml) in marine and estuarine waters were as follows: Chesapeake Bay surface, 1200; Chesapeake Bay bottom, 90; Narragansett Bay, 60; Atlantic Ocean at Cape Henry, 60 near land and 20 in open ocean; and Puerto Rico, 100. Ratios of heterotrophic bacteria to Gram positive cocci wer 2600, 36700, 150, 20, 10, and 9, respectively. Staphylococcus spp. comprised 92% of Gram positive cocci, with Micrococcus (8%) and streptococcus spp. found rarely, except at the Puerto Rican Trench dump site. Staphylococci were not abundant near land. Staphylococcus hominis was dominant at all but the Narragansett Bay station, where S. epidermidis was isolated. Highest bacterial counts were found in water of lowest salinity. (Cassar-FRC)
W83-02391

DETERMINING THE CONCENTRATION OF EASILY ASSIMILABLE ORGANIC CARBON IN DRINKING WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 5F.
W83-02397

THE EFFECT OF ENVIRONMENTAL FACTORS ON THE SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
Liverpool Polytechnic (England). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W83-02402

COMPARATIVE STUDY OF CONFIRMATION MEDIA FOR DETECTING GROUP D STREPTOCOCCI,
Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
A. H. Havelaar, P. D. Tips, and H. W. B. Engel.
Water Research, Vol 16, No 12, p 1605-1609, December, 1982. 6 Tab, 13 Ref.

Descriptors: *Bacteria, *Streptococcus, *Culture media, *Pollutant identification, Azide dextrose media, Bacterial analysis, Fecal bacteria, Water pollution, Wastewater pollution, Natural waters.

Four media for confirming the presence of group D streptococci in azide dextrose broth enrichment cultures at 37C were compared. The subculture systems were ethylviolet azide broth, azide dextrose broth, bile esculin azide agar, and K-F streptococcus agar. Ethylviolet azide broth at 37C failed to support growth of all group D streptococci tested and gave positive reactions with some non-group D strains. The characteristic purple button was frequently absent. Azide dextrose broth incubated at 44C also inhibited some group D streptococci and was sensitive to overgrowth by catalase-positive bacteria. Bile esculin azide agar incubated at 44C supported growth of group D almost exclusively but was the most inhibitory of all media tested in this study. K-F streptococcus agar at 37C gave positive reactions with most group D streptococci and with many non-group-D strains. The most accurate results can be obtained by using a combination of bile esculin azide agar and K-F streptococcus agar. (Cassar-FRC)
W83-02412

BACTERIOLOGICAL AND VIROLOGICAL ANALYSIS OF WATER FROM FOUR FRESH WATER BEACHES,
Institut Armand-Frappier, Laval (Quebec).
P. Payment, M. Lemieux, and M. Trudel.
Water Research, Vol 16, No 6, p 939-943, June, 1982. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Bioindicators, *Pollutant identification, *Viruses, *Turbidity, *Separation techniques, *Sewage bacteria, Water analysis, Bacteria, Salmonella, Coliforms, Streptococcus, Enteric bacteria, Beaches, Lakes, Water pollution, Quebec, Deux-Montagnes Lake.

Group 5A—Identification Of Pollutants

Water samples were collected from four public beaches located on Deux-Montagnes Lake during July and August of 1979 to evaluate the extent of viral pollution in recreational waters, to study the efficiency of two viral concentration methods, and to assess the adequacy of bacterial standards to monitor viral pollution. One twenty-liter water sample was taken from each of the four locations and analyzed for total coliforms, fecal coliforms, fecal streptococci, salmonellae, and enteric viruses. Viruses were effectively concentrated by filtration on a stack of 142 millimeter-size fiberglass filter discs, followed by a hydroextraction procedure. Statistical analysis of the data showed no correlation between the presence of viruses and enteric bacteria and no correlation between the presence of salmonellae and other bacterial indicators. When turbidity was greater than 10 nephelometric turbidity units, a positive correlation between virus isolation and water turbidity was apparent. Further studies are needed to see if correlations exist between viral concentrations in public bathing waters and disease incidence. (Geiger-FRC)
W83-02417

5B. Sources Of Pollution

APPRAISAL OF GROUND-WATER QUALITY NEAR WASTEWATER-TREATMENT FACILITIES, GLACIER NATIONAL PARK, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
J. A. Moreland, and W. A. Wood.
Geological Survey Water-Resources Investigations 82-4, June 1982. 27 p, 8 Fig, 5 Tab, 1 Ref.

Descriptors: *Groundwater, *Water quality, *Data collections, *Monitoring, *Observation wells, Sites, Sampling, Trace elements, Drillers logs, Water level, Groundwater movement, Wastewater treatment, Effluents, Waste disposal, Geohydrology, *Montana, Glacier National Park.

Water-level and water-quality data were collected from monitoring wells at wastewater-treatment facilities in Glacier National Park. Five additional shallow observation wells were installed at the Glacier Park Headquarters facility to monitor water quality in the shallow ground-water system. Water-level, water-quality, and geologic information indicate that some of the initial monitoring wells are not ideally located to sample ground water most likely to be affected by waste disposal at the sites. Small differences in chemical characteristics between samples from monitor wells indicate that effluent may be affecting ground-water quality but that impacts are not significant. Future monitoring of ground-water quality could be limited to selected wells most likely to be impacted by percolating effluent. Laboratory analyses for common ions could detect future impacts. (USGS)
W83-02115

WATER-QUALITY CHARACTERISTICS OF EVERGLADES NATIONAL PARK, 1959-77, WITH REFERENCE TO THE EFFECTS OF WATER MANAGEMENT,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-228941, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-34, 1982. 51 p 15 Fig, 9 Tab, 25 Ref.

Descriptors: *Water quality, *Surface water, *Marshes, Environmental effects, Path of pollutants, Water management, Data collections, Ions, Nutrients, Pesticides, Chemical analysis, *Florida, Everglades National Park, Everglades.

The U.S. Geological Survey has collected water-quality data in the Everglades National Park since 1959. Major ions, macronutrients, trace elements, and pesticides are the primary chemical groups analyzed. The period of record and frequency of sampling vary for each chemical group, with the longest record for the major ions and the shortest for the macronutrients. Within the park there are three major drainageways: Big Cypress Swamp, Shark River Slough, and Taylor Slough. Each drainageway exhibits unique hydrologic conditions, yet there is a high degree of homogeneity in water-quality characteristics among these areas. Seasonal changes in major-ion, trace-element, and macronutrient concentrations are marked in the shallow marsh. Concentrations generally increase in the dry season due to evapotranspiration, changes in chemical equilibria, and precipitation. Water-management practices in south Florida have changed the water quality in the Shark River Slough. Most major-ion, dissolved-solid, and iron concentrations and color levels have steadily increased since 1963. The water quality in the other two drainageways has not changed since sampling began. Chlorinated-hydrocarbon insecticide residues in bottom material were found in low concentration at every sampling station in the park. (USGS)
W83-02117

ORGANIC MATTER LOADING AND PROCESSING IN A PRISTINE STREAM DRAINING A TALLGRASS PRAIRIE/RIPARIAN FOREST WATERSHED,
Kansas Water Resources Research Inst., Manhattan.
M. E. Gurtz, G. R. Marzolf, K. T. Killingbeck, D. L. Smith, and J. V. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173245, Price codes: A05 in paper copy, A01 in microfiche. Contribution No 230, November 1982. 78 p, 24 Fig, 114 Ref, 2 Append. OWRT B-063-KAN(1), 14-34-0001-0264.

Descriptors: *Organic matter, *Watersheds, Intermittent streams, Storm runoff, Riparian vegetation, Decomposition, *Organic loading, Stream banks, Ephemeral streams, Hydrographs, Seston, Throughfall, Prairie, *Litterfall, *Dissolved organic matter, *Kansas, Kings Creek watershed, *Forest watersheds, *Grasses, *Tallgrass.

The stream chosen for study lies within the Kings Creek watershed of Konza Prairie Research Natural Area, a tallgrass prairie site near Manhattan, Kansas. The primary purpose in this organic matter investigation was to provide an observational basis for future research relating to water quality. Secondly, there was need to study the ecology of the tallgrass prairie stream to evaluate present understanding of stream ecosystem. Organic matter contributions to the stream were estimated for one year. Coarse particulate allochthonous organic matter was collected as direct litterfall and lateral movement. Dissolved organic carbon entering the stream channel was estimated by collecting throughfall in areas representing the three riparian zones. Direct litterfall was contributed mostly by grasses and herbaceous vegetation. Rate of direct litterfall was highest in the gallery forest. Inputs from lateral movement were mostly grass. Most of the deciduous tree species exhibited autumn peak of direct litterfall. Wood collection differed distinctly from leaf inputs, being particularly high in summer. Grass inputs apparently were greatest during summer and early autumn. Composition of stored organic matter varied with changes in riparian vegetation along the longitudinal gradient. Grass dominated storage in the upland region, while leaves and wood were more abundant in lower reaches. Two points emerged that may be useful to improve water quality: 1. Decomposition of organic matter by native stream biota in the headwaters should be maximized. 2. Preserving natural retention structures in headwaters will maximize decomposition.
W83-02133

CAUSES OF ACIDIFICATION OF FOUR STREAMS ON LAUREL HILL IN SOUTHWESTERN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
D. R. DeWalle, W. E. Sharpe, R. S. Dinicola, R. T. Leibfried, and W. G. Kimmel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173278, Price codes: A04 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, Pennsylvania State Univ., University Park, December 1982. 62 p, 12 Tab, 14 Fig, 19 Ref. OWRT B-117-PA(2), 14-34-0001-0277.

Descriptors: Water quality, Streams, *Fishskills, *Storm runoff, Fish populations, Snowmelt, Snowpack pollutants, Snowpacks, Base flow, *Pennsylvania, *Hydrogen ion concentration, *Acidification, *Acid precipitation, Laurel Hill, Aluminum concentration, Buffering capacity, Atmospheric deposition, *Soil leachate, Poorly buffered streams, Geologic influences.

Possible sources of acidity were investigated for four streams on Laurel Hill (southwestern Pennsylvania) where fishkills have been reported since 1960. A study of the chemistry of atmospheric deposition, soil leachate and stream water and fish populations was conducted on these basins during 1980-81, emphasizing dormant season periods with runoff from snowmelt and rain. Although bedrock geology altered the natural buffering capacity of these streams, only acid precipitation could be linked to sharp drops in pH and increases in total aluminum concentrations observed during storm-flows in the poorly-buffered streams. Three poorly-buffered streams exhibited drops to pH 4.4 - 4.5 and increases in total aluminum concentrations up to 1.5 mg/l during observed peak flows. Mineral soil leachate from the three major soil series on the basins exhibited a low pH of 4.3 and average total aluminum concentrations of 3.6 mg/l, indicating stream response during storms was closely linked to chemistry of soil leachate. Poorly-buffered streams did not support reproducing populations of trout or other fishes. In contrast, one well-buffered stream (equivalent 20 mg/l CaCO sub 3) only exhibited drops to pH 5.5 during peak flow and supported reproducing trout and sculpin populations. The loss of fish populations in poorly-buffered streams was attributed to acidification of forest soils by precipitation.
W83-02136

CONTAMINANT LEVELS IN PRECIPITATION AND URBAN SURFACE RUNOFF,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
M. Owe, P. J. Craul, and H. G. Halverson.
Water Resources Bulletin, Vol 18, No 5, p 863-868, October, 1982. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Urban runoff, *Runoff, *Precipitation, Water pollution sources, Fate of pollutants, Metals, Hydrocarbons, Transporation, Zinc, Lead, Copper, Cadmium, Pollutant load, Fallout, *New York, Syracuse.

Heavy metals and petroleum hydrocarbons concentrations were determined in samples of precipitation and runoff collected at a shopping mall near Syracuse, New York, during 12 storms in the 1979 hydrologic year. Levels of contaimants (mg per liter) in precipitation were: Pb, 0.058-0.186; Zn, 0.047-0.183; Cu, 0.005-0.095; Cd, 0.001-004; and hydrocarbons, none. Levels of contaminants (mg per liter) in all surface runoff were: Pb, 0.74-2.97; Zn, 0.89-4.74; Cu, 0.12-1.38; Cd, 0.01-0.28; and hydrocarbons, 3.83-19.71. There was no correlation between precipitation contaminant concentrations and length of antecedent dry period. A weak inverse relationship was observed between concentraton and amount of precipitation. Poor correlations were obtained between runoff contaminant levels and length of antecedent dry period. However, the dryfall accumulation value, which accounted for different precipitation volumes and contaminant loads, was well correlated with length of antecedent dry period. Metal ions were probably derived from atmospheric fallout, from both distant sources and the automobile traffic at the mall. Hydrocarbon residues were solely the result of automobile losses. (Cassar-FRC)
W83-02156

ESTUARINE SEDIMENT CONTROLS ON TRACE METAL DISTRIBUTIONS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
R. J. Davies-Colley, P. O. Nelson, and K. J. Williamson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175208, Price codes: A11 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-75, Oregon State University, Corvallis, January 1982. 224 p, 7 Fig, 7 Tab, 288 Ref, 4 Append. OWRT A-051-ORE(1).

Descriptors: *Trace metals, *Copper, *Cadmium, *Sediment contamination, Estuaries, Sediment Phases, Estuarine sediments, Metal uptake, Absorption, *Path of pollutants, Fate of pollutants, Water pollution sources.

The sedimentary partitioning of copper and cadmium was examined with the goal of predicting the environmental fate of these toxic metals in estuaries. Trace metal binding in oxidized sediments was simulated with five solid phases: synthetic hydrous oxides of iron and manganese, montmorillonite clay, a synthetic aluminosilicate gel, and estuarine humic sustances (EHS) extracted from a natural sediment. The uptake of copper and cadmium by these model phases in artificial seawater was measured as a function of pH and salinity. The affinity for cadmium was in the following order: manganese > iron > aluminosilicates > montmorillonite. Copper binding affinities were much higher but the relative order of affinity of the phases was similar. Metal binding was not influenced by interactions involved in iron-clay, iron-humic and clay-iron-humic phase complexes. This suggests that experiments with isolated phases are adequate to predict partitioning. A simple model was calibrated for predicting partitioning and total metal uptake by sediments. This model, predicts that cadmium uptake by estuarine sediments is dominated by iron while both iron and organics are important for copper. Selective extraction studies and studies of cadmium uptake by natural estuarine sediments give semiquantitative agreement with these predictions. In anaerobic sediments, thermodynamic calculations suggest that copper and cadmium concentrations are determined by equilibria involving solid sulphides and bisulphide and polysulphide complexes.
W83-02175

HEAVY METALS IN ACID PRECIPITATION,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
D. R. Hemenway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175273, Price codes: A03 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Univ. of Vermont, Burlington, December 1982. 30 p, 9 Fig, 7 Tab, 7 Ref. OWRT A-046-VT(1).

Descriptors: *Acid rain, *Acid precipitation, *Heavy metals, Aluminum, Lead, Cadmium, Vanadium, *Vermont, Sampling, Data collections, Path of pollutants, *Pollutant identification, Water pollution sources.

Precipitation samples were collected sequentially on a sub-event basis. Specific contaminants in the segmented precipitation samples were measured for seven separate events. The concentration of Al, Cd, Pb, and V in the subsamples of each event analyzed were determined along with sample pH. In the last three events, sulfate, nitrate, and chloride concentrations were also measured. The subsamples for each event were filtered through a 0.1 um membrane filter in an attempt to separate particulate matter from soluble species. Filtrate concentrations were as high as 243 ug/L, 53 ug/L, 91 ug/L and 8.3 ug/L for Al, V, Pb, and Cd, respectively, for the initial sub-sample. The only metal investigated associated with the suspended particulate was Al with concentration of up to 350 ug/L in the initial sub-samples. SO sub 4, NO sub 3, and Cl showed similar trends as pH during the course of an event. These concentrations were always high at the onset of precipitation, lowering as the event continued, but once again increasing, in differing degrees, in the final sub-samples. Results indicate that chemical constituents in precipitation vary greatly with time. Removal of certain contaminants may be greatly affected by scavenging efficiencies of cloud and rain drops, and aerodynamic and chemical behavior of the aerosol rather than simple washout/dilution effects.
W83-02182

DISTRIBUTION OF PHOSPHORUS IN COLUMNS OF VERY SANDY SOILS AFTER LEACHING WITH WATER OR DIAMMONIUM PHOSPHATE SOLUTIONS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W83-02199

PHOSPHORUS AND ORGANIC CARBON IN THE SEDIMENTS OF A POLLUTED SUBTROPICAL ESTUARY, AND THE INFLUENCE OF COASTAL RECLAMATION,
Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and S. K. Yeung.
Marine Pollution Bulletin, Vol 13, No 10, p 354-359, October, 1982. 5 Fig, 19 Ref.

Descriptors: *Phosphorus, *Harbors, *Estuaries, Sedimentation, *Sediments, Organic compounds, Water pollution effects, Phosphates, Tolo Harbour, *Hong Kong, Water quality.

Total phosphorus and organic carbon were determined in the sediments of Tolo Harbour in July 1978. The harbor is a sewage polluted estuary in north-east Hong Kong. Concentrations were correlated with the percent silt-clay in each of three areas. Phosphorus concentrations were highest in central Tolo Harbour, lower by about 1.5 microgram-atom P per g in the outer estuary, Tolo Channel, and lowest in the polluted inner reaches near large coastal reclamations. The latter values, about 3.0 microgram-atoms P per g lower than in central Tolo Harbour, might reflect a selective adsorption of phosphate by reclamation sediments. Organic carbon concentrations were high in the inner reaches and decreased towards the outer channel. Correlations between phosphorus and organic carbon were compared with a published correlation for the east coast of England. In Hong Kong the phosphorus concentration showed a smaller increase as organic carbon increased, and reached only one-third of the English values as organic carbon approached 2.0%. (Baker-FRC)
W83-02203

HEAVY METALS IN THE TIBER RIVER BASIN,
Istituto di Ricerca sulle Acque, Rome (Italy).
M. Pettine, T. La Noce, G. Macchi, and F. J. Millero.
Marine Pollution Bulletin, Vol 13, No 9, p 327-329, September, 1982. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *River basins, *Heavy metals, *Pollutant identification, Water pollution sources, Metals, Cadmium, Iron, Manganese, Copper, Lead, Zinc, Suspended sediments, *Tiber River, River basins, *Italy.

Water samples were taken from the Tiber River basin and analyzed for metal content. Concentrations of metals tended to increase, generally from the upper Tiber waters to the river mouth, as a consequence of the natural process of erosion and anthropogenic activities in the basin. The increase is not very great because industrial activity in the area is not highly developed. The total concentration of metals as well as the distribution between the soluble and particulate phase at the river mouth are strongly influenced by the flow conditions and the suspended matter concentration of the river. The total concentration of metals, as well as the solid load, increases during the season of high flow conditions as a consequences of the efficiency of land drainage. The Tiber River appears not to change significantly the quality of the coastal waters in terms of the metals studied. A reassessment of heavy metals in the Mediterranean open sea waters would probably change this conclusion. (Baker-FRC)
W83-02205

THE ROLE OF LAKE AND RESERVOIR SEDIMENTS AS SINKS IN THE PERTURBED GLOBAL CARBON CYCLE,
Oak Ridge National Lab., TN.
P. J. Mulholland, and J. W. Elwood.
Tellus, Vol 34, No 5, p 490-499, October, 1982. 3 Fig, 5 Tab, 52 Ref.

Descriptors: *Sinks, *Sedimentation, *Carbon cycle, Lakes, Reservoirs, Carbon, Fuels, Sediments.

Recent increases in organic carbon accumulation in the sediments of lakes and reservoirs are estimated. The possibility that, as a result of some of man's activities, the rate of net carbon accumulation in the sediments of inland waters has increased in recent years, removing fossil fuel carbon from the atmosphere and accounting for a portion of the 'missing' carbon in current global carbon budget estimates, was investigated. The findings proved that the role of inland aquatic sediments as sinks in the global carbon cycle is significant although small compared to that of terrestrial systems and the oceans. Rates of organic carbon accumulation in the sediments of inland aquatic ecosystems appear to be related to the flushing rates of these systems. The highest accumulation rates are found in systems which have relatively large inputs of terrestrial organic matter. These systems usually have high watershed area:water surface area ratios, but also have sufficient water residence times for substantial sedimentation of allochthonous inputs and medium to high autochthonous production. (Baker-FRC)
W83-02206

RELATIONSHIP BETWEEN TOPOGRAPHIC POSITION AND CONTAMINATION OF WATER RESOURCES BY REFUSE LANDFILLS,
Iowa State Water Resources Research Inst., Ames.
L. V. A. Sendlein, R. C. Palmquist, T. E. Fenton, and L. D. Drake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177949, Price codes: A06 in paper copy, A01 in microfiche. Publication No 65, January 1983. 106 p, 45 Fig, 16 Tab, 25 Ref. OWRT A-047-IA(3), 14-31-0001-4015, 14-31-0001-3515, 14-31-0001-3815.

Descriptors: *Landfills, *Leachates, Groundwater contamination, *Iowa, *Illinois, *Path of pollutants, Waste disposal, Land disposal, Topography, Sites, Fate of pollutants.

Several upland and floodplain sanitary landfill sites were investigated to determine the size, shape and composition of the leachate plume. Movement of pollutants was found to be parallel to the flow lines in a compact, flume-shaped malenclave. Leachate concentrations are highest along an axis parallel to the groundwater flow lines. The closer the disposal site to a river the minimum the area of contaminated groundwater. In upland sites, migration was primarily downward with little lateral migration. No significant adverse effect of leachate on surface water quality was determined.
W83-02209

CHEMICAL AND MICROBIOLOGICAL COMPOSITION OF DRAINAGE WATERS IN FLOODPLAIN SOILS BEING DRAINED,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tomsk (USSR).
L. I. Inisheva, and A. N. Vasil'eva.
Water Resources (English Translation), Vol 9, No 1, p 98-104, January/February, 1982. 3 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 147-153, January/February, 1982.

Descriptors: *Drainage water, *Microorganisms, *Chemical analysis, Water analysis, Water quality, Drainage, Surface waters, Floodplains, Land reclamation, Surface runoff, Soils, Oxidation, *USSR, Kiya River.

Investigations of the chemical composition of drainage waters were carried out in the subtaiga zone, in the floodplain of the Kiya river in the Zyryansk region of the Tomsk district on a polder-

type land reclamation project. Tile drainage was constructed on the system in 1974-76. The study concluded that in the floodplain soils the mobility of the main nutrients and also of calcium, magnesium, iron, sulfates, and bicarbonates is limited. Peat bog soils were distinguished by a higher content of available forms of the given elements. This is one of the reasons for the evaluated concentrations of these elements found in the drainage waters of these soils. In intensely drained soils the content of available forms of chemical compounds increased under the effect of aerobic soil biota, which promoted their removal with the drainage runoff. To prevent the decomposition of peat to water-soluble compounds, the moisture content of the reclaimed soils should be kept close to the field capacity for the greater part of the growing season, which will equalize the ratio of aerobic and anaerobic microflora. (Baker-FRC)
W83-02256

DIFFUSION OF A PASSIVE SCALAR WITH RANDOM ADVECTION,
Oak Ridge National Lab., TN.
J. E. Molyneux, and A. J. Witten.
Water Resources Research, Vol 16, No 1, p 137-144, February, 1980. 4 Fig, 9 Ref.

Descriptors: *Solute transport, *Stochastic process, *River flow, Fate of pollutants, Flow velocity, Probabilistic process, Statistical analysis, *Path of pollutants, Model studies, Advection, Passive scalers.

The instantaneous release of a passive (nonreacting) additive into a flow is investigated, assuming that the concentration of the additive is governed by the one-dimensional advective diffusion equation in which the advecting flow velocity is a given time-dependent stochastic process. Both one- and two-space-time point probability distributions of the random concentration field were determined. This problem is an idealized model of accidental or planned release of contaminants into a river by a power station or other source. Previous treatments of this problem have focused on deriving information about the statistical moments of the concentration. This paper shows a more complete statistical description. In the case of accidental releases of pollutants, the time of release and river flow are unknown. Using results obtained in this paper and long-term statistics of river flow, the impact of the accident can be assessed probabilistically. (Cassar-FRC)
W83-02265

PETROLEUM HYDROCARBONS IN URBAN RUNOFF FROM A COMMERCIAL LAND USE AREA,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
E. J. Hoffman, J. S. Latimer, G. L. Mills, and J. G. Quinn.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1517-1525, November, 1982. 6 Fig, 9 Tab, 27 Ref.

Descriptors: *Hydrocarbons, *Urban runoff, *Storm water, Runoff, Fate of pollutants, Water pollution sources, Rain storms, Suspended solids, Particulate matter, Paving, Oil pollution, *Rhode Island.

Petroleum hydrocarbons were determined in storm runoff from a shopping mall in Warwick, Rhode Island. The samples were collected during 6 rainstorms lasting from 1.5 to 13 hours and depositing 0.05 to 1.60 inches of rainfall. The loads of suspended solids (SS) and hydrocarbons varies widely over the progress of a storm, highest concentrations and loads being associated with the first flush (first major peak in flow rate). SS concentrations (in mg per liter) ranged from 1.6 to 12.0 minimum and 47.5 to 252.0 maximum (flow weighted means, 20.5-112.7 mg per liter). Total hydrocarbons concentrations (mg per liter) were: 0.059-0.450 minimum to 1.13-5.70 maximum (flow weighted means, 0.69-2.15). Loading was essentially linear with total rainfall, suggesting that the supply of pollutants had not been exhausted in storms up to the largest (1.60 in) but could approach a limit in storms > 1.90 in. Between 83 and 93% of total hydrocarbons were associated with the particulates. These solids contained 1.7-33% hydrocarbons. Gas chromatographs of the runoff hydrocarbons and automotive crankcase oil were very similar. (Cassar-FRC)
W83-02281

USE OF ATMOSPHERIC FLUOROCARBONS F-11 AND F-12 TO DETERMINE THE DIFFUSION PARAMETERS OF THE UNSATURATED ZONE IN THE SOUTHERN HIGH PLAINS OF TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
E. P. Weeks, D. E. Earp, and G. M. Thompson.
Water Resources Research, Vol 18, No 5, p 1365-1378, October, 1982. 7 Fig, 4 Tab, 44 Ref.

Descriptors: *Fluorocarbons, *Soil gases, *Tracers, *Organic compounds, Diffusion, *Texas, Tortuosity, Sorption, Model studies, Porous media, Gas transport, Porosity, Water table decline, Dating, Groundwater dating, High Plains, *Path of pollutants, Radioactivity.

Studies of the diffusive movement of volatile solutes through the unsaturated zone are important in hydrologic research because the evaluated parameters affect the movement and distribution of volatile organic or radioactive contaminants from the land surface to the groundwater reservoir, or from buried waste to the land surface. These studies may also aid in interpreting groundwater ages based on the presence of atmospheric gases. Trichlorofluoromethane (F-11) and dichlorodifluoromethane (F-12) were measured in soil air in the unconsolidated sedimentary deposits at four sites in the Amarillo-Lubbock region of semiarid Texas. At the relatively undisturbed Glenn site, fluorocarbon concentrations of soil gas decreased with depth; the F-12/F-11 ratio also increased with depth. Fluorocarbon concentrations at the other three sites did not show the expected pattern due to effects of other experiments or a perched groundwater body. An analytical model and a finite-difference model, both based on molecular diffusion theory, were used to assess the field results. Effective diffusion coefficients were 0.04 sq m per day (F-11) and 0.09 sq m per day (F-12), compared with the theoretical values of 0.78 and 0.86 sq m per day in free air. This demostrated the combined effects of tortuosity, solubility, and sorption in retarding the transport of fluorocarbons through the unsaturated zone. Tortuosity values depended on the distribution coefficient used and were affected by solid-gas partitioning but not by moisture content or drained porosity. Tortuosity values and numerical modeling of results agreed closely with values calculated from published theoretical and empirical relationships. (Cassar-FRC)
W83-02289

BIOGEOCHEMISTRY OF ARSENIC MINE DRAINAGE,
Alaska Univ., Fairbanks. Inst. of Water Resources.
H. V. Luong, J. M. Forshaug, and E. J. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180273, Price codes: A02 in paper copy, A01 in microfiche. Completion Report 79-21, November 1981. 20 p, 1 Fig, 2 Tab, 6 Ref. 1 Append. OWRT B-045-ALAS(1), 14-34-0001-0202.

Descriptors: *Arsenic compounds, *Mine drainage, Mine water, Mining, *Gold, Hydraulic mining, *Placer mining, Lode mining, *Thiobacillus spp., *Alaska, Aquatic bacteria.

Arsenic is enriched in gold and sulfide deposits throughout many areas of Alaska. Consequently, some stream waters, stream sediments and groundwaters contain dissolved arsenic concentrations in excess of the Environmental Protection Agency's recommended limit of 50 parts per billion (pbb: Wilson and Hawkins, 1978) We report here that the acidiophile, T. ferrooxidans is present in most neutral pH subarctic streams affected by gold mining activities. Some of these streams have measurable levels of dissolved arsenic while others do not. We also report that the presence of T. ferrooxidans increases the rate that arsenic leaches from gold-bearing material at least fourfold over the abiotic leaching rate. In summary, we have found that high numbers of acidophilic bacteria exist in mine drainage that contains arsenic. This provides indirect evidence that microbial activity is associated with increased levels of arsenic in streams and groundwaters. Heavy metal leaching may yet prove to be from localized pyritic material via the conventional 'acid-mine drainage' mechanisms, via some as yet undiscovered biochemical mechanism, or even via a strict chemical equilibrium process in the presence of incidental populations of T. ferrooxidans. Whatever the mechanism of heavy metal leaching in the areas described, mining activity continues to increase. We feel, therefore, that studies of the biogeochemistry of those areas should continue.
W83-02290

TOXAPHENE,
California State Water Resources Control Board, Sacramento.
D. B. Cohen, G. W. Bowes, and S. M. Ali.
Special Projects Report No 82-4SP, June 1982. 126 p, 17 Fig, 35 Tab, 140 Ref, 9 Append.

Descriptors: *Chemical wastes, *Agricultural wastes, *Insecticides, *Pesticides, *Toxicity, Contamination, Volatility, Aquatic environment, Aquatic life, Sediments, Carcinogens, Nonpoint pollution sources, DDT, Polychlorinated biphenyls, Pollutants, Fishkill.

Toxaphene, a potent insecticide, has been detected in parts of the world far from areas of use and may be as significant a global contaminant as DDT and PCB. Its use has been banned in the U.S. and in some countries. Use in California has declined from 3 million pounds in 1973 to 0.5 million pounds in 1980. Toxaphene enters the atmosphere primarily via drift from aerial applications and volatilization from soil, water and plant canopy. the most significant impact on beneficial uses of water is its toxicity to aquatic life. It is chronically toxic at extremely low concentrations and acutely toxic to freshwater fish at low parts per billion levels. Mean residue concentrations in fish have increased since 1970. Little is known about toxaphene's toxicity to humans but it was determined to be an animal carcinogen. Point source discharges can occur from manufacturers, formulators and applicators. Non-point source losses to the atmosphere have been estimated to average over 60% of the material applied. Every effort needs to be made to mitigate further contamination of the environment, such as by soil and water conservation to minimize runoff and soil loss, installing sediment traps below treated water shed areas, and using different insecticides. Recommendations are suggested for many state and federal agencies, including California's Water Resources Control Board and the Regional Water Quality Control Boards, the U.S. EPA, the U.S. Fish and Wildlife Service, Department of Food and Agriculture, and the Department of Health Services. (Atkins-Omniplan)
W83-02299

CHARACTERISTICS OF MUNICIPAL WASTEWATERS,
Southern California Coastal Water Research Project Authority, Long Beach.
For primary bibliographic entry see Field 5A.
W83-02301

METAL INPUT AND MOBILIZATION IN TWO ACID-STRESSED LAKE WATERSHEDS IN MAINE,
Maine Univ. at Orono. Land and Water Resources Center.
J. S. Kahl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182022, Price codes: A06 in paper copy, A01 in microfiche. M.S. Thesis, December 1982. 108 p, 28 Fig, 16 Tab, 123 Ref, 4 Append. OWRT A-053-ME(1).

Descriptors: *Acid rain, Forest soils, *Heavy metals, Sediment-water interfaces, *Maine, Lake watersheds, *Acid-stressed lakes, *Precipitation

chemistry, *Sediment chemistry, Surface water chemistry, Acidified waters, Buffering, Soil profiles, Soil cores.

Two small lakes in Hancock County (ME), Little Long Pond and Second Pond, were compared with respect to atmospheric deposition, aqueous chemistry, and metal mobilization from sediments. The ponds have similar granitic bedrock, elevation, watershed areas, soil composition, and atmospheric deposition of acids and metals, but they exhibit marked differences in surface water pH. Little Long Pond is acidic (pH 4.5-5.6), whereas Second Pond is circumneutral (pH 6.0-6.8) and has higher dissolved cation concentrations. These differences are caused at least in part, by thinner soils, greater relief, and more exposed bedrock in Little Long watershed, compared to Second Pond watershed. Dated sediment chemical profiles indicate that accelerated sedimentation of PB and Zn began in the mid-1800's in both ponds, presumably due to increased atmospheric deposition. Little Long Hypolimnetic sediments show concurrent depletion in Ca, Mn, and more recently, Zn. Experiments with limnocosms show that up to 50% of the Ca and Mn, and 25% of the Zn, in recent sediments may be leached at a pH near 4.0 in less than a year, suggesting that in-situ leaching may be an important influence on sediment chemistry in acidic waters. Nearly 10% of the Ca and Zn was mobilized at pH 5.0. Except for the epilimnetic Little Long cores (greater Mn release), and the hypolimnetic Little Long cores (less Ca release), the sediments from different sites and lakes responded similarly to experimental acidification in the laboratory. However, Al release by Little Long sediments was relatively more important in buffering acid inputs, whereas Ca was more important in Second Pond sediments.
W83-02328

CHEMICAL TRANSPORT IN A FISSURED ROCK: VERIFICATION OF A NUMERICAL MODEL,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson, T. N. Narasimhan, and I. Neretnieks.
Water Resources Research, Vol 18, No 5, p 1479-1492, October 1982. 15 Fig, 4 Tab, 22 Ref.

Descriptors: *Model studies, *Geologic fractures, *Waste storage, *Radioactive wastes, *Advection, Diffusion, Computers, Mathematical equations, *Advective diffusion equation.

A numerical model, TRUMP, has been verified which solves the advective diffusion equation in general three dimensions, with or without decay and source terms. The method is based on an intergrated finite difference approach. The model was verified against known analytic solutions of the one-dimensional advection-diffusion problem, as well as the problem of advection-diffusion in a system of parallel fractures separated by spherical particles. The studies show that as long as the magnitude of advectance is equal to or less than that of conductance for the closed surface bounding any volume element in the region, the numerical method can indeed match the analytic solutions. The realistic input parameters used in the sample calculations suggest that such a range of Peclet numbers is likely to characterize deep groundwater systems in granitic and ancient argillaceous systems. Thus TRUMP provides a viable tool for use in nuclear waste evaluation studies. A disadvantage of TRUMP is that the iterative method of solving the set of simultaneous equations is rather slow when time constants vary widely over the flow region. Although the iterative solution may be very desirable for large three-dimensional problems to minimize computer storage, it seems desirable to use a direct solver technique in conjunction with the mixed explicit-implicit approach whenever possible. (Baker-FRC)
W83-02349

ENVIRONMENTAL ASPECTS OF ORGANICS IN SELECTED COAL CONVERSION SOLID WASTES,
Oak Ridge National Lab., TN.
M. G. Browman, and M. P. Maskarinec.
Journal of Environmental Science nd Health, Part A, Vol 17, No 5, p 737-766, 1982. 1 Fig, 7 Tab, 31 Ref.

Descriptors: *Organic compounds, *Coal gasification, *Waste characteristics, Aromatic compounds, Aliphatic compounds, Polynuclear aromatic hydrocarbons, Coal liquefaction, Fly ash, Industrial wastes, Waste storage, Leachates, Hydrocarbons, Pollutant identification.

The speciation and quantities of organic compounds were determined in selected coal conversion wastes: ash, char, and/or slag from 8 medium/high Btu gasification processes and temporarily stored liquefaction solids (vacuum still bottoms and a spent product-filter material). Entrained-flow, fixed bed, and fluidized bed process wastes were represented. Extracts of the materials were prepared by continuous methylene chloride extraction for 18 hours and by stirring with water for 24 hours. In general, organic concentrations were much lower in gasification wastes than in the temporarily stored liquefaction solids. Recovery of added benz(a)anthracene by methylene chloride extraction ranged from 2.5 to 100%. Gasification wastes contained 0-6.3 micrograms per g methylene chloride extractable aromatics and 0-70 micrograms per g aliphatic hydrocarbons. The liquefaction solids contained 75-760 and 260-1300 micrograms per g aromatic and aliphatic hydrocarbons, respectively. Aqueous extracts of the wastes contained 0.2-2.1 mg per liter dissolved organic carbon, except for one liquefaction waste sample with 90 mg per liter dissolved organic carbon. The pH values of the aqueous extracts were 3.9-9.8. The phenols and cresols in the temporarily stored spent product-filter material could degrade surface and groundwater quality if exposed to the weather. All other materials were considered no significant threat to water quality. (Cassar-FRC)
W83-02357

NUTRIENT REMOVAL AND LEACHING FROM A WHOLE-TREE HARVEST OF NORTHERN HARDWOODS,
Northeastern Forest Experiment Station, Durham, NH. Forestry Sciences Lab.
J. W. Hornbeck, and W. Kropelin.
Journal of Environmental Quality, Vol 11, No 2, p 309-316, April-June, 1982. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Erosion, *Nutrient removal, *Forest management, Leaching, Nitrate, Soil solution, Calcium, Potassium, Phosphorus, Nitrogen, Water pollution, Watersheds, Biomass, Hardwood, *New Hampshire.

Whole-tree harvesting of northern hardwood stands in New England at shortened intervals has raised concerns about nutrient depletion, leaching of nutrients into streams, and possible declines in site productivity. Whole-tree harvesting at the site investigated resulted in the removal of an average of 111 dry metric tons of biomass per hectare, representing about 95% of the above ground total. Nutrient removal in the harvested trees averaged 344, 242, 128, and 19 kilograms per hectare for calcium, nitrogen, potassium, and phosphorus, respectively, which was between 1 and 3% of the estimated total soil capital for these nutrients. About 30% of the total estimated available calcium capital and about 85% of the total estimated available potassium captial was removed. Nitrate (N03), calcium, and potassium concentrations in soil solution and streamflow of the harvested watershed increased for about 2 years. Concentrations of both nitrate and calcium returned to background levels in the soil solution by the third growing season after the harvest. Increased mineralization and nitrification immediately after harvest are thought to cause the increases in nutrient ions in streams and soil solution. The nutrient removal and leaching losses in themselves do not seem to deplete total nutrient capital significantly, but the whole-tree harvesting method may affect the processes, mechanisms, and rates by which these nutrients are made available for future stands. (Carroll-FRC)
W83-02359

AMMONIUM IN THE DUWAMISH ESTUARY: NITRIFICATION, SEDIMENT RELEASE AND TOXICITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
W. T. Trial, and E. B. Welch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182105, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series Technical Report No 78, University of Washington, Seattle, July 1982. 87 p, 26 Fig, 7 Tab, 56 Ref, 3 Append. OWRT A-109-WASH(1).

Descriptors: *Ammonium, *Nitrifying bacteria, *Estuary, *Sediments, Water column, *Washington, Duwamish Estuary, Seattle, *Nitrification, *Toxicity, Path of pollutants, Water pollution effects.

Ammonium in the Duwamish Estuary, Seattle was examined using data obtained from laboratory and field measurements. The isolation of nitrifying bacteria by the MPN technique showed these organisms to be primarily associated with estuary sediments rather than the water column. The rate of nitrification in the estuary determined in situ was calculated based on the increased in nitrite (NO2) and Nitrate (NO3) nitrogen during a time of travel survey down the estuary. This rate was considered to be best represented by a zero order sediment based process and expressed on an areal basis as 970 milligrams per square meter per day. Using this rate over the study reach, 13% of the non-dilutional decrease in ammonium concentration could be accounted for while a 19% decrease in ammonium was observed. Nitrification in vitro was determined in chambers containing water and sediment collected from the estuary. Rates of nitrification were observed to decrease when sediments of the lower estuary were in contact with low (4%) versus high (20%) salinity water. Interstitial ammonium in sediments of the lower study reach (below kilometer 10) was shown to be higher than that in the overlying water column while this gradient was reversed in the upper study reach (kilometer 21-10). Experimental results in vitro showed sediments of the lower estuary to release ammonium to the water column. An increase in the concentration of unionized ammonia (NH3) was calculated based on the projected increase of secondary effluent discharged to the estuary. An increase in NH3 to toxic levels may occur but only if phytoplankton bloom activity increased instream pH to 8.5 or greater.
W83-02368

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE I,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5E.
W83-02372

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES III HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS (MOSSEL BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 2, p 108-113, April, 1982. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Metals, *Chromium, *Estuaries, *Industrial wastes, Baseline studies, *Sediments, Heavy metals, Monitoring, Trace metals, Trace elements, Water analysis, Fate of pollutants, Core logging, Rivers, *South Africa, Mossel Bay.

Surveys were conducted in July 1978 to study the metal contents of the Hartenbos, Little Brak and Great Brak Rivers which empty from urban and industrial settlements into Mossel Bay. Water samples were analyzed for 13 elements, and surface sediments and sediment core samples for 16 elements by atomic absorption spectroscopy. Data were analyzed for absolute metal concentrations as well as inter-element relationships. Results show that all three South African rivers suffer from some degree of metal contamination. The extreme-

ly high chromium levels in parts of the Great Brak River could present a threat to estuarine flora and fauna if mobilized by flooding. However, other metal levels in this and the other two rivers do not, at present, pose a significant pollution threat. These findings may serve as a baseline reference for further pollution monitoring. (Geiger-FRC)
W83-02376

SOLIDS CONTAMINATION RESULTING FROM DRAINAGE WORKS IN AN UPLAND CATCHMENT, AND ITS REMOVAL BY FLOTATION,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5F.
W83-02377

GROUNDWATER POLLUTION: A CASE STUDY,
Waterloo Regional Municipality (Ontario). Marshland Centre.
For primary bibliographic entry see Field 5G.
W83-02378

DISTRIBUTION OF NUTRIENT SALTS IN THE LOWER REACHES OF THE TIGRIS AND EUPHRATES, IRAQ,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad.
Water Supply and Management, Vol 6, No 5, p 443-453, 1982. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Nutrients, *Seasonal variation, *Nitrates, *Nitrites, *Phosphates, *Silicates, Rivers, Fate of pollutants, Tigris River, Euphrates River, Shatt al-Arab, *Iraq, Phytoplankton, Suspended sediments, Water pollution sources, *Path of pollutants.

Nutrients were determined in water samples collected on the surface, middle, and bottom at four stations in the Tigris-Euphrates-Shatt al-Arab river system during January, April, August, and October 1974. Nitrates were absent in April and in all but the middle and bottom samples at one station in January. The low levels were a result of adsorption onto flood-carried sediments, use by phytoplankton, and increases in nitrate reduction. High levels were caused by sewage input, agricultural runoff, and decomposition of organic matter. Nitrate levels increased to 62.0-159.5 micrograms per liter in August and 35.4-443.0 micrograms per liter in October. Nitrites were present throughout the year in all samples. Levels were lowest in April (13.2-26.3 micrograms per liter) and August (13.2-19.7 micrograms per liter) and higher in January (19.7-46.1 micrograms per liter) and October (19.7-39.5 micrograms per liter). Nitrite levels were lower during the high temperature months when transformations to nitrate or ammonia were active. High levels were a result of reduction of nitrate and nitrification of ammonia. Phosphates were absent in April due to adsorption onto suspended sediments and uptake by phytoplankton. High values in October (150-240 micrograms per liter) were related to paper factory discharges and releases from decaying organic matter and bottom sediments. Silicates varied from 3.10-4.60 micrograms per liter in January to 8.77-8.99 micrograms per liter in August. These concentrations were related to the diatom population and mixing. The large pollutant load (industrial effluents, untreated domestic wastes, and agricultural runoff) discharged into Shatt al-Arab is expected to increase with further development. Water pollution controls are suggested to minimize the further deterioration of the rivers. (Cassar-FRC)
W83-02380

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES IV KEURBOOMS AND BIETOU RIVERS (PLETTENBERG LAGOON),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water SA, Vol 8, No 2, p 114-119, April, 1982. 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Metals, *Water pollution sources, *Monitoring, *Water analysis, *Estuaries, Baseline studies, *Urbanization, Heavy metals, Trace metals, Trace elements, Fate of pollutants, Sediments, Core logging, Rivers, South Africa, Plettenberg Lagoon.

Water, surface sediment, and sediment core samples were taken in July 1978 from the Keurbooms and Bietou Rivers and analyzed for several metals by atomic absorption spectroscopy. The data will serve as baseline information for future monitoring surveys as further urbanization of the Plettenberg Lagoon area occurs. Results were analyzed for absolute metal concentrations as well as inter-element relationships. The present findings show that these rivers and their common estuary are not significantly contaminated by metals. Considerable metal loading in the Bietou River was attributed to geochemical sources, while metal build-up in the southwestern section of the estuary adjacent to the town of Plettenberg Bay was most likely caused by urban development. (Geiger-FRC)
W83-02390

MOVEMENT OF ORGANIC CONTAMINANTS IN GROUNDWATER: IMPLICATIONS FOR WATER SUPPLY,
Stanford Univ., CA. Dept. of Environmental Engineering.
P. V. Roberts, M. Reinhard, and A. J. Valocchi.
Journal of the American Water Works Association, Vol 74, No 8, p 408-413, August, 1982. 5 Fig, 1 Tab, 32 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Sorption, *Advection, *Degradation, Adsorption, Air-water interfaces, Aquifer, Organic carbon, Molecular structure, Water pollution sources, Reviews, *Path of pollutants, Octanol.

The occurence, behavior, and treatment of contamination of groundwater by organic compounds are reviewed. Organic solute behavior in groundwater includes sorption, dispersion, advection, and degradation. Transport equations are presented. Treatment of organic contaminants is influenced by the octanol: water partition, air stripping, and adsorption. Advection and dispersion of organics in the subsurface cannot be predicted accurately but must be measured by means of tracer experiments in the field. Sorption can be predicted based on the octanol:water partition of the solute and the organic carbon content of the aquifer material. Degradation rates are dependent upon molecular structure and environmental conditions. Stimulus-response experiments are useful, as they can provide information on the behavior of organic solutes in the sub-surface environment. Knowledge of the solute transport rate and dynamic behavior are necessary for the design of groundwater quality monitoring systems. (Small-FRC)
W83-02399

PRINCIPLES OF ORGANIC CONTAMINANT BEHAVIOR DURING ARTIFICIAL RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and A. J. Valocchi.
The Science of the Total Environment, Vol 21, 1981. p 161-172. OWRT C-80264-R(8842)(1).

Descriptors: *Groundwater, Data collections, *Porous media, Water quality, Aquifers, *Dispersion, *Artificial recharge, *Path of pollutants, *Attenuation, *Retardation factor, *Organic chemicals, Water pollution sources.

The behavior of a variety of organic contaminants having low molecular weight has been observed during groundwater recharge with reclaimed water. The evidence is site-specific, but is believed to have broader implications regarding the general behavior or organic contaminants in groundwater. The movement of specific contaminants such as chloroform and chlorobenzene is retarded with respect to that of a conservative tracer such as chloride. The measured retardation factors are approximately 3 and 35 for chloroform and chlorobenzene, respectively. The retardation is caused by the sorption of the solute, apparently by the organic constituents of the soil material. The magnitude of the retardation factor of an organic solute can be predicted approximately from knowledge of the organic carbon content of the aquifer material and the octanol-water partition coefficient of the solute. Sorption also contributes to attenuation (damping) of concentration fluctuations. It is shown that the degree of attenuation depends strongly on the retardation factor, the distance traveled, and the hydrogeologic characteristics of the aquifer. There is evidence of biodegradation of organic solutes in the vicinity of the recharge well.
W83-02405

BACTERIAL DEGRADATION OF COAL CONVERSION BY-PRODUCTS (POLYCYCLIC AROMATIC HYDROCARBONS) IN AQUATIC ENVIRONMENTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, and T. W. Sherrill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187161, Price codes: A05 in paper copy, A01 in microfiche.
Tennessee Water Resources Research Center Research Report No 89, Univ. of Tennessee, Knoxville, 1982. 80 p, 4 Fig, 26 Tab, 35 Ref. OWRT B-040-TENN(3), 14-34-0001-9096.

Descriptors: Hydrocarbons, Degradation, Aquatic environment, *Biodegradation mineralization, *Microbial degradation, Metabolism, Carcinogens, Tenax, Phenanthrene, Reservoirs, Tennessee, Naphthalene, Benzo (a) pyrene, *Aromatic hydrocarbons, *Polyaromatic hydrocarbons.

Studies were undertaken to determine the potential for degradation of polyaromatic hydrocarbons (PAH) by the naturally occuring microbial populations in aquatic environments. The investigation utilized laboratory and field studies to assess the PAH biodegradative capabilities of water column and sediment samples. Phenanthrene was incubated with water samples in order to evaluate the potential for significant PAH degradation by the indigenous microbial populations. Biodegradation was assessed by comparison of total PAH substrate recovery in degradation flasks relative to sterile control flasks. A rapid Tenax-GC extraction technique was evaluated and found to be quantitatively efficient and reproducible for PHE. Nephthalene (NAP), PHE and benzo (a) pyrene (BP) were employed as substrates for PAH boidegration by microbial populations in sediments. Biodegration was assessed by mineralization of the 14C-PAH substrates incubated in sediment slurries. Mineralization rate constants and substrate turnover times were calculated for the PAH mineralization studies. Sediment microcosms treated with individual PAH or a synthetic oil (SO) were sampled after various periods of acclimation to determine the effect upon the PAH mineralization while BP was inhibitory. The SO treatment caused a substantial enhancement of PAH mineralization. PAH mineralization in sediments was related to the length of incubation time, temperature, molecular size of the substrate, bacterial populations and previous treatment with PAH or related contaminants. Lower molecular weight PAH are subject to biodegration in aquatic environments, while larger PAH are more resistant to microbial decomposition.
W83-02409

MICROBIAL UPTAKE OF CADMIUM AND ITS EFFECTS ON THE BIOCHEMICAL OXYGEN DEMAND AT VARIOUS TEMPERATURES,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, A. Ahmad, and A. A. Nomani.
Water Research, Vol 16, No 12, p 1611-1614, December 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Cadmium, *Bacteria, *Accumulation, Fate of pollutants, Metals, Heavy metals, *Sewage bacteria, Bioaccumulation, Water pollution effects, *Biochemical oxygen demand, Temperature.

Removal of cadmium from water by sewage bacteria was studied at pH 7 using glycine as a carbon source. Temperatures were 20, 30, 40 and 50C; Cd concentrations (mg per liter) were 0.0437 (control),

0.437, 0.875, and 1.31. The rate constant and ultimate BOD were used as measures of the toxic effects. After 8 days the percentages of Cd consumed were: 21.8-24.7% at 20C, 24.76-31.46% at 30C, 29.64-32.40 at 40C, and 14.04-19.67 at 50C. The rate constants decreased with increasing Cd concentration. Rate constants on the first day of incubation at the control Cd concentration were 0.174 for 20C, 0.203 for 30C, 0.205 for 40C, and 0.197 for 50C. (Cassar-FRC)
W83-02414

POLLUTION PATTERN SURVEILLANCE ON A RIVER USED AS A DRINKING WATER SOURCE: THE RIVER MEUSE,
Antwerpse Waterwerken (Belgium). Labs. Dept.
W. Van Craenenbroeck.
Water Research, Vol 16, No 12, p 1577-1589, December, 1982. 17 Fig, 4 Tab, 18 Ref.

Descriptors: *Monitoring, *Self-purification, *Pollution load, Meuse River, *Belgium, The Netherlands, Fate of pollutants, Water pollution sources, Thermal pollution, Thermal discharges, Heated water, Cooling water, Suspended solids, Organic matter, Salts, Chlorides, Water temperature, Temperature, Nutrients, Nitrogen, Ammonia, Phosphorus, Water supply.

A comprehensive water quality surveillance system for the River Meuse, Belgium-Netherlands, was established during the early 1960's. The system now includes 18 sampling points on the river and associated canals. At several major sampling points water is analyzed weekly for 50 parameters; at minor sampling points, monthly for 10 parameters. Most sampling points are impacted by cooling water discharges, which favor growth of pathogenic organisms. Suspended solids levels (maximum in late fall) are strongly influenced by conveyance of coal particulates, dredging, and navigation. Annual, weekly, and daily cycles in suspended solids concentrations are apparent. Levels of organic substances reflect inputs from industries and rivers, natural humic substances, regions of self-purification, and seasonal variations. Levels of nutrients, derived from coke oven effluents (ammonia), sewage, and agricultural sources, are affected by river flow volumes. Mean N load in the Meuse for 1962-78 was 70 tons per day, maximum 140 tons per day in 1965 and 1970. Mean P load was about 3 tons per day during 1962-71 and 10 tons per day during 1972-78. Of the various cations and anions represented in the river water, chloride is most important. Mean chloride mass flow was 664 tons per day in 1962-80. Soda and chlorine factories discharge significant quantities of sodium and calcium chlorides. The accumulation of data from this surveillance program allows formation of a predictive model for raw water quality at various water supply intakes. (Cassar-FRC)
W83-02415

PARTITIONING OF C14 PCB BETWEEN WATER AND PARTICULATES WITH VARIOUS ORGANIC CONTENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
G. M. Nau-Ritter, C. F. Wurster, and R. G. Rowland.
Water Research, Vol 16, No 12, p 1615-1618, December, 1982. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Polychlorinated biphenyls, *Solubility, *Particulate matter, Fate of pollutants, Organic compounds, Chlorinated hydrocarbons, Partition coefficients, Adsorption, Organic matter, Suspended sediments, *Illite, Sea water.

Concentration factors (all times 10,000) for C14-labeled polychlorinated biphenyls (PCB) onto particulates in seawater were: 1.09 for 100% illite, 1.16 for 95%-5% illite-organic matter; 1.33 for 90%-10% illite-organic matter; and 4.92 for 100% organic matter. Desorption of the PCB-contaminated particles resuspended in clean water was rapid for 1.5 to 2 hours, then reached equilibrium. After desorption, 100% organic matter had significantly higher PCB contents than 100% illite. (Cassar-FRC)
W83-02416

TRITIUM IN GROUNDWATERS OF THE CENTRAL SECTION OF THE BAIKAL-AMUR MAIN LINE ROUTE,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. V. Romanov, V. A. Pavlov, V. A. Petrukhin, E. I. Andrievskii, and A. P. Malykhin.
Water Resources, Vol 9, No 1, p 22-26, January-February, 1982. 1 Fig, 3 Tab, 8 Ref. Translated from Vodnye Resursy, No 1, p 48-53, January-February, 1982.

Descriptors: *Groundwater movement, *Tritium, *Water exchange, Precipitation, Radioisotopes, Groundwater dating, Baikal-Amur Railroad, *USSR, Fate of pollutants, Recharge, Groundwater recharge.

Tritium levels were investigated in groundwater of the central section of the Baikal-Amur railroad line, USSR, in July 1977 and May 1979 to acquire information on the quality and hydrodynamic regime of these potable supplies. Tritium concentrations at 16 wells and springs were several orders lower than maximum levels specified in drinking water standards. The times of exchange of groundwater in this region estimated with 3 models were 30-50 years. Therefore the entry of polluted surface waters can have significant effects on aquifers. In the most intensely exploited groundwater fields there were larger differences between tritium levels between 1977 and 1979. Exchange times were 30-40 years. Intense exploitation disrupts natural recharge and can capture surface water or water from lower-lying aquifers. (Cassar-FRC)
W83-02443

THE WHANGAEHU RIVER - AN ACID BATH,
Rangitikei-Wanganui Catchment Board (New Zealand).
C. Fowles.
Soil and Water, Vol 17, No 2, p 27-29, April, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality, *Rivers, *Acidic water, *Seasonal variation, *Diversion, Snowmelt, Industrial wastes, Pulp and paper industry, Acidity, Acid streams, Volcanoes, Monitoring, Water pollution sources, *New Zealand, Whangaehu River.

Water quality along the Whangaehu River, New Zealand is affected by volcanic mud deposits and the input of industrial wastes at Tangiwai. Water quality in the winter months is generally good and improves with the onset of the warmer months, when tributaries contribute high quality waters from snowmelt. In 1979, 22 of the western tributaries of the Whangaehu River were diverted by the Western Diversion of the Tongariro Power Development Scheme to flow into the newly-created Moawhango Lake. Water rights were approved for the construction of the Kariori hydroelectric power scheme, which will divert water via canals from the Tokiahuru Stream into a storage lake, and then to the Whangaehu River. A continuous monitoring station was set up at Tangiwai to monitor water quality of the Whangaehu River after the Wahianoa Aqueduct Diversion projects were completed. Stainless steel housings were required for all monitoring instruments to protect the electrodes from the acidity of the water. Although a slower improvement in water quality now occurs below the Tokiahuru Stream confluence, little change to the quality normally measured prior to diversion was found in the central and lower river reaches. (Geiger-FRC)
W83-02449

5C. Effects Of Pollution

PHYCOLOGICAL STUDIES IN LAKES ONTARIO, ERIE, HURON, AND SUPERIOR,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W83-02102

CHLORINATION OF ESTUARINE WATER: THE OCCURRENCE AND MAGNITUDE OF CARBON OXIDATION AND ITS IMPACT ON TRACE-METAL TRANSPORT,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
J. G. Sanders.
Environmental Science and Technology, Vol 16, No 11, p 791-796, November, 1982. 5 Fig, 7 Tab, 27 Ref.

Descriptors: *Chlorination, *Organic carbon, *Chelation, *Cooling water, Estuaries, Patuxent River, *Maryland, Oxidation, Copper, Trace metals, Fate of pollutants, Water pollution effects, Salinity, Chalk Point, Power plants, *Carbon oxidation.

Samples of estuarine water, salinity 0-10 o/oo, from Patuxent River, Chesapeake Bay, were chlorinated to levels of 0.05 to 10 mg per liter for periods of 1 to 30 days. Chlorination changed the original dissolved organic carbon (DOC) levels of 2.7-6.0 mg per liter and the composition of the mixture. This was monitored by loss of total DOC and changes in the molecular weight distribution of carbon. Losses of organic carbon varied from none to 50 micromol per liter (average 35), or 0 to 0.6 mg per liter. Carbon loss was not dependent on initial concentration of DOC or level of chlorination. Carbon loss occurred in all but one sample with salinities $>$ 5 o/oo but not in any sample of lower salinity. In all samples chlorination also increased the percentage of lower molecular weight compounds due to degradation of macromolecules. 30% of the copper was associated with the $<$ 1000 mol wt fraction and 70% with the $<$ 10,000 mol wt fraction in both control and chlorinated samples. The quantity of carbon oxidized was small compared with the total complexation capacity of estuarine waters. Therefore, chlorination is not likely to cause shifts in metal speciation. However, coprecipitation with Mn and Fe oxyhydroxides was greater in chlorinated samples. Since a large portion of Patuxent River flow passes through the cooling system of the Chalk Point powerplant during low flow, it is estimated that organic carbon removal by chlorination could remove 11% of the river's DOC in an average year and 40% in an extreme low flow year. (Cassar-FRC)
W83-02104

EPIDEMIOLOGIC IMPACT OF WATER REUSE IN LOS ANGELES COUNTY,
California Univ., Los Angeles. School of Public Health.
For primary bibliographic entry see Field 3C.
W83-02105

ACID PRECIPITATION EFFECTS ON ALGAL PRODUCTIVITY AND BIOMASS IN ADIRONDACK MOUNTAIN LAKES,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
G. R. Hendrey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173203, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, December 1982. 8 p, 2 Tab, 11 Ref. OWRT A-078-NY(1), 14-34-0001-8034, 9034, 0134.

Descriptors: *Phytoplankton, *Acid precipitation, Primary production, Biomass.

Relationships between phytoplankton communities and lake acidity in three Adirondack Mountain Lakes were studied at Woods Lake (pH ca. 4.9), Sagamore Lake (pH ca. 5.5), and Panther Lake (pH ca. 7.0). Numbers of phytoplankton species observed were Woods 45, Sagamore 55, and Panther 85, conforming to observations at many other sites that species numbers decrease with increasing acidity. Peak Chl. a and productivity values, respectively, were Woods 6.8 mg m super -2 and 21 mg m super -2 hr super-1; Sagamore 12.2 mg m super -2 and 16 mg m super -2 hr super -1; and Panther 23 mg m super -2 and 52 mg m super -2 hr super -1. Patterns of increasing biomass and productivity in Woods Lake may be atypical of similar oligotrophic lakes in that they develop rather slowly to maxima six weeks after ice-out, instead of occurring very close to ice-out. Phytoplankton

productivity averaged from ice-out through July 31, 1979, were 12 mg m super -2 hr super -1, 10 mg m super -2 hr super -1, and 30 mg m super -2 hr super -1 for Woods, Sagamore, and Panther. Contributions of netplankton (net > 48 u m), nannoplankton (48 > nanno > 20 um) and ultraplankton (20 > ultra > 0.45 um) to productivity per m super -2 show that the smaller plankton are relatively more important in the more acid lakes, Woods > Sagamore > Panther (p. < .05). This pattern could be determined by nutrient availability (lake acidification is suspected of leading to decreased availability of phosphorus). The amount of 14 sub C-labelled dissolved photosynthate (14 sub C-DOM), as a percent of total productivity, is ordered Woods > Sagamore > Panther. This was consistent with a hypothesis that microbial heterotrophic activity is reduced with increasing acidity, but the smaller phytoplankton may be more 'leaky' at low pH. Analyses of stored samples for Total-P and zooplankton were curtailed due to lack of funds.
W83-02129

FOOD QUALITY OF AUFWUCHS FROM ARTIFICIAL STREAMS RECEIVING LOW LEVELS OF PERTURBATIONS,
Environmental Research Lab., Gulf Breeze, FL.
J. R. Clark, D. S. Cherry, and J. Cairns, Jr.
Water Resources Bulletin, Vol 18, No 5, p 761-767, October, 1982. 4 Tab, 42 Ref.

Descriptors: *Streams, *Food chains, *Sublethal effects, Water pollution effects, Copper, Chlorine, Glucose, Carbohydrates, Protein, Organic compounds, Algae, Aufwuchs, Periphyton, Species composition, *Cyanophyta, Heterotrophic bacteria, Bacteria.

Measurements of Aufwuchs food quality (protein, carbohydrates, and organic content) in artificial streams provided information on species abundunce shifts as reactions to low level perturbations such as addition of chlorine, copper, and dextrose, at final concentrations of 0.2, 0.05, and 1-2 ppm, respectively. Protein content increased with increasing domination by blue-green algae or heterotrophs. Blue-green algae were numerous under copper or chlorine treatments and as water temperature approached the seasonal maximum, 22.8-25.8C. Heterotrophs were predominant in dextrose-enriched streams. Carbohydrate content of Aufwuchs was higher in the presence of blue-green algae or bacteria, but decreased under Cl or Cu treatments at low or moderate temperatures (3-22.8C), indicating utilization of stored photosynthetic products to adapt to the stress. The organic content of Aufwuchs was related to the extent of mucilage produced and the tendency of the community to accumulate detritus and suspended sediments. The food quality of Aufwuchs is important in evaluating the impact of pollutants on grazers and higher trophic levels. (Cassar-FRC)
W83-02148

WATER RESOURCES AND HUMAN HEALTH: THE VIEWPOINT OF MEDICAL GEOGRAPHY,
Hunter Coll., New York. Dept. of Geology and Geography.
A. Van Burkalow.
Water Resources Bulletin, Vol 18, No 5, p 869-874, October, 1982. 40 Ref.

Descriptors: *Public health, *Diseases, *Geography, Human diseases, Medical geography, Water resources development, Water pollution effects, Trace elements, Hot springs, Mineral springs, Springs, Fluorine, Lithium, Pathogens, Waste disposal, Recreation, Irrigation, Transportation.

Medical geography is concerned with areal patterns of human health and disease and the contributing environmental and cultural factors. Water resources are an important aspect of these studies for several reasons: they are essential to life, provide beauty and inspiration, and are partially responsible for more than 80% of all disease. Inorganic factors in human health and disease associated with ground and surface waters include minerals dissolved in water (hot springs, fluorine as related to teeth, lithium as a mood stabilizer, iodine in goiter treatment and prevention, and water hardness as related to cardiovascular disease). Organic factors include pathogens (bacteria, viruses, fungi, worms, etc.), nonhuman hosts such as snails carrying schistosomiasis, and vectors such as mosquitoes. The cultural environment can cause and spread human disease through pollution by municipal, agricultural, and industrial wastes; religious practices (bathing in the polluted Ganges River or traveling to religious shrines); recreation (crowding in resort areas and swimming in polluted waters); building reservoirs and irrigation projects (schistosomiasis and mosquito-borne diseases); transportation (highway deicers and lead from gasoline); and water softening. Cultrual practices also protect against waterborne diseases: insect control, drinking water protection and treatment, trace element removal or addition, and vaccinations. (Cassar-FRC)
W83-02168

THE ROLE OF GIZZARD SHAD (DOROSOMA CEPEDIANUM) IN EUTROPHIC FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W83-02184

SEDIMENT TOXICITY AND THE DISTRIBUTION OF AMPHIPODS IN COMMENCEMENT BAY, WASHINGTON, USA,
Corvallis Environmental Research Lab., OR.
R. C. Swartz, W. A. Deben, K. A. Sercu, and J. O. Lamberson.
Marine Pollution Bulletin, Vol 13, No 10, p 359-364, October, 1982. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Sediments, *Bays, *Hazardous materials, Waste disposal, Hazardous waste, *Toxicity, Environmental effects, Commencement Bay, *Amphipods, Water quality, *Washington, Puget sound.

Commencement Bay of Puget Sound, Washington, has long received hazardous wastes containing organic and inorganic toxic materials from a variety of industrial sources. The toxicity of 175 sediment samples from Commencement Bay was measured by the survival of marine infaunal amphipods (Rhepoxynius abronius) during ten day exposure to the test sediment. Survival was high in sediment from offshore, deeper parts of the Bay, including two designated dredge material disposal sites. Within each of the major industrialized waterways there was a wide range in amphipod survival. Both acutely toxic and relatively nontoxic samples were collected from various areas within the Hylebos, Blair, Sitcum and City Waterways. Habitat differences, sedimentation rates, proximity to contaminant sources and sinks, and disruption of the seabed by prop scour and dredging could contribute to this variation in toxicity. Community structure data show a correlation between amphipod distribution and sediment toxicity, with lower amphipod density and species richness in the waterways than in the deeper part of the Bay. Phoxocephalid amphipods, a family that includes the bioassay species, were ubiquitous in the deeper Bay, but absent from the waterways. This correlation between laboratory and field results indicates the ecological relevance of the sediment bioassay. (Baker-FRC)
W83-02204

A LABORATORY/FIELD INVESTIGATION INTO THE BIOLOGICAL EFFECTS OF URBAN RUNOFF,
Massachusetts Univ., Amherst. Water Resources Research Center.
C. Medeiros, and R. A. Coler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177956, Price codes: A05 in paper copy, A01 in microfiche. Publication No 130, July 1982. 65 p, 20 Tab, 11 Fig, 69 Ref. OWRT A-126-MASS(1), 14-34-0001-9023.

Descriptors: *Urban runoff, *Fish toxins, *Toxicity, Water quality, Macroinvertebrates, *Heavy metals, Fathead minnows, Brook trout, Black Nose Dove, *Massachusetts, Greenfield, Green River, *Lethal limit.

The effects of urban runoff on the hatchability, survival and growth of Pimephales promelas was assessed in the laboratory using flow-through (proportional diluter) and static (38.1 aquaria) systems. In the field, urban runoff was assessed using artificial substrates/live traps to derive diversity, survival, and metal accumulation values. To correlate toxicity with water quality, chemical analyses were performed on water, suspended solids, and sediments at 2 river stations and 2 runoff input sources. Results showed a large variability in runoff chemistry between seasons and even within the same storm. The long term toxicity tests with the fathead minnow showed growth to be limited to 50% of control values at approximately 60% of full strength. The maximum allowable toxicant concentration (MATC), on the other hand, was approximately 28%. Hatchability and average length as indicators of stress, were not as sensitive as millimeters produced per treatment and maximum and minimum sizes. The field studies largely confirmed the laboratory chronic studies. Significant differences in survival, diversity, and heavy metal accumulation did not occur until snow melting or rain events occurred. During such periods, diversity values approached one half those of the controls, and heavy metal content was 2 to 10 times control levels.
W83-02210

A SURVEY OF SEDIMENT DISCHARGE AND SHELF REEF CONDITIONS,
Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178012, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 34 p, 10 Fig, 3 Tab, 10 Ref. OWRT A-059-PR(1), 14-34-0001-1141.

Descriptors: *Sediment discharge, *Coral, *Reefs, Carbonate rocks, *Puerto Rico, Zonation, *Marine sediments.

Coral can tolerate turbid conditions and sediment stress to some extent. The zonation of the reef is, however, dependent on light intensities and the corals have different susceptibilities to direct sediment cover. It has been found that Acropora palmata was the most sensitive to application of silty sediments in field conditions and that Agaricia agaricites, Porites asteroides, and Acropora cervicornis had lower net productivity after application of silt than other corals. This explains in part that the depth zonation not only changes upward from an increase in turbid water, but the new assemblage is missing some of the deeper water corals and there has been a change in the abundances and dominant species not explained by a simple response to light loss. The environments of Mayaguez, Anasco and Guayanilla Bays were once favorable to coral development. This is attested to by fairly large, well developed reef tracts in all of these areas. At the present time, more than 50% of the original reef is no longer living and there is no evidence of regeneration or development of new reef areas. There does appear to be a continuous record of loss of total reef area which is likely to continue. (Munoz, Puerto Rico)
W83-02216

BACTERICIDAL SERUM RESPONSE OF THE CHANNEL CATFISH AGAINST GRAM-NEGATIVE BACTERIA,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth, and E. A. Wilson.
Developmental and Comparative Immunology, Vol 6, 1982. p 579-583, 1 Tab, 10 Ref. OWRT A-057-TN(2), 14-34-0001-9045.

Descriptors: *Catfish, *Fish diseases, *Fish farming, Fish, *Viruses, *Bacteria, *Fish toxins, Immunity, Water pollution effects.

The purpose of this investigation was to determine if fresh channel catfish serum from unimmunized catfish is bacterial against 14 different Gram-Negative and Gram-Positive bacteria. The objective was to see if serum from the unimmunized catfish is bactericidal to these different bacterial species and how great the percentage of bactericidal activity may be as the percentage could vary among bacterial species. If a low percentage of bactericidal activity by fresh catfish serum is found against a Gram-Negative pathogen, then that could be an important reason why it is a successful fish pathogen. The channel catfish (Ictalurus punctatus), a teleost fish, is extensively used in aquaculture in Southeast U.S.A. It therefore becomes important to study what role catfish serum performs in bactericidal action and thus immunity against bacterial fish infections and diseases.
W83-02219

ALTERNATE PATHWAY OF COMPLEMENT AND BACTERICIDAL RESPONSE OF THE CHANNEL CATFISH TO SALMONELLA PARATYPHI,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth, and E. A. Wilson.
-34-0001-9045.

Descriptors: *Catfish, *Bacteria, *Salmonella, Fish, Viruses, *Fish diseases, *Fish Toxins, Serum, Immunity, Antitoxins, Water pollution effects.

Fresh Channel Catfish (Ictalurus punctatus) serum from unimmunized catfish exhibited 100% bactericidal activity against Salmonella paratyphi. Components responsible for bactericidal activity could be absorbed from the fresh catfish serum with S. paratyphi. The bactericidal system of the fresh catfish serum showed a need for magnesium rather than for calcium after EDTA treatment. The additions of salicylaldoxime or ammonium hydroxide to catfish serum indicated the alternate rather than the classical pathway of complement activation to be important in bactercidal activity against S. paratyphi. Bactericidal activity of catfish serum was labile when incubated at 47C for 30 min., stable for at least 4 mo. at -80C and could be absorbed with S. paratyphi at 25C. Very minimal bactericidal activity was present in the descending portion of the first 13.7S peak with most activity being found in the descending portion of the second 7.1S peak and throughout the entire 3.4S peak after Sephadex G-200 catfish serum fractionation.
W83-02220

NEUTRALIZATION OF BACTERIAL EXOTOXIN (TETANUS TOXIN) BY CHANNEL CATFISH IGM ANTIBODY,
Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth.
Immunology, Vol 45, 1982. p 49-53, 1 Fig, 2 Tab, 15 Ref. OWRT A-057-TN(3), 14-34-0001-9045.

Descriptors: Fish, Viruses, *Bacteria, *Fish diseases, *Fish toxins, *Catfish, Tetanus, Immunity, Serum, Antitoxins, Water pollution effects.

A bacterial exotoxin neutralization response by fish IgM antibody has not been demonstrated previously in any fish species. Channel catfish, Ictalurus punctatus, were immunized intraperitoneally with alum-absorbed tetanus toxoid. Catfish immune serum demonstrated 1.28 antitoxin units (a.u.) of antitoxin neutralization and gave an indirect haemagglutination (IHA) titre of 1:65, 536. After 2-mercaptoethanol (2ME) reduction of immune serum, no antitoxin neutralization remained but an IHA serum titre of 1:4096 was present. After Sephadex G-200 gel filtration of the catfish immune serum, the 14S antibody gave 0.32 a.u./ml and an IHA titre of 1:256. The 7S antibody gave no antitoxin neutralization but an IHA titre of 1:512 was found. After 2ME reduction, neither the 14S or 7S globulins demonstrated antitoxin neutralization, but minimal IHA titres of 1:16 and 1:4, respectively, were still found. The catfish immune serum and the 14S and 7S globulins did not precipitate tetanus toxoid by immunodiffusion in 1% agar gel.
W83-02221

THE ECOLOGICAL EFFECTS OF PULP LOG SALVAGE ON FISH COMMUNITIES IN A RESERVOIR,
Maine Univ. at Orono.
M. T. Negus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178079, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, August 1982. 86 p, 14 Fig, 3 Tab, 96 Ref. University of Maine at Orono. OWRT B-020-ME(2), 14-34-0001-0226.

Descriptors: Fish diets, Fish food organisms, Fish migration, Fish populations, Fisheries, *Logging, *Ecological effects, Water pollution effects, *Maine, Kennebec River, Wyman Lake, Reservoirs, Yellow perch, Golden Shiners.

One hundred forty years of log driving in the Kennebec River left an estimated one to two million cores of spruce and fir pulpwood logs submerged in Wyman Lake. Commercial salvaging of these logs from 1979-81 prompted a study to assess the importance of these logs to fishes, and the effects of log salvaging on fishes. Techniques employed in this study were vertical gill netting, radio tracking, and stomach content analysis. The vertical distribution of the various fish species in the water column and the horizontal distribution of fishes in different parts of the lake indicate some habitat segregation by fish species. Yellow perch (Perca flavescens) were significantly more numerous in sites without logs, and numbers of suckers (Catostomus spp.), golden shiners (Notemigonus crysoleucas), chain pickerel (Esox niger), and pumpkinseed (Lepomis gibbosus) were significantly higher in sites with logs. Yellow perch were usually captured near the lake bottom, and most other species tended to be distributed higher in the water column. The relationships of these distributions to the presence of logs are questionable. Radio tracking data indicate yellow perch tend to concentrate movements near a home area, but movements may range widely. Yellow perch preyed more heavily on cladocerans in sites without logs, and on larger invertebrates in sites with logs. These differences in food habitats could reflect different prey availability due to physical variations between study areas. However, coefficients of condition of yellow perch and common shiners were significantly higher in areas without logs. Moderate log salvage operations would probally have little impact on the fishes of Wyman Lake, if certain precautions were taken.
W83-02227

BIOLOGICAL INDICATION OF WATER QUALITY: THE GEOGRAPHIC ASPECT,
All-Union Scientific-Industrial Association of the Pulp and Paper Industry, Moscow (USSR).
For primary bibliographic entry see Field 5A.
W83-02236

CHANGE IN THE SYSTEM OF CARBON COMPOUNDS IN LAKES UNDER THE EFFECT OF HUMAN ACTIVITIES,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
E. A. Rumyantsev.
Water Resources (English Translation), Vol 8, No 6, p 660-665, November/December, 1981. 1 Fig, 4 Tab, 6 Ref. Translated from Vodnye Resursy, No 6, p 152-158, November/December, 1981.

Descriptors: *Lakes, *Eutrophication, *Water pollution sources, Industrial waste, Dairy wastes, Farm wastes, Carbon, Organic compounds, Water pollution effects, Water quality, *USSR, Estonia, Latvia.

Water quality of lakes undergoing a natural evolutionary process was compared to that in lakes which had been disturbed by anthropogenic influences. In order to study the most common properties of the system of carbon compounds and its transformation under the effect of human activity, all the compounds were reduced to functionally different groups: carbon of mineral compounds, carbon of dissolved organic materials, and carbon of suspended organic materials. The eutrophic lakes included in the study were contaminated by the wastewaters of a dairy, the use of the drainage basin for plowland, and the retting of flax. The waters of lakes influenced by man's activities had a significantly higher total carbon content. (Baker-FRC)
W83-02248

HYDROBIOLOGICAL EVALUATION OF WATER QUALITY OF A MULTIPURPOSE RESERVOIR SUBJECTED TO THE EFFECT OF INDUSTRIAL WASTEWATERS,
Dnepropetrovskii Gosudarstvennyi Univ. (USSR).
Yu. K. Gaidash, A. K. Dyga, and V. I. Zolotareva.
Water Resources (English Translation), Vol 8, No 6, p 655-660, November/December, 1981. 2 Tab, 9 Ref. Translated from Vodnye Resursy, No 6, p 145-151, November/December, 1981.

Descriptors: *Water quality, *Reservoirs, *Water pollution effects, Industrial wastes, Wastewater disposal, Environmental effects, Indicator organisms.

The regularities of formation of the fanual complexes of plankton and macrobenthos, structure of zoocenoses, and degree of alterations of the biofilter, consisting of benthic organisms, were examined under conditions of a regulated streamflow in the case of inflow of pollutant into a reservoir typical for the southern slope of the country from its drainage area and with the wastewaters of industrial enterprises. The following biological criteria were used to assess the level of pollution: species composition, their number and biomass, presence of indicator organisms, and structure of communities. Plankton and benthic communities at sites of distribution of wastewaters continue to exist and function as an integral system, but the pressure of pollution is so powerful that the communities of organisms cannot cope with the pollutants being introduced in the upper and, to some extent, the middle stretches of the reservoir under study. It is concluded that it is necessary to use the most radical means for protecting multipurpose reservoirs under conditions of a strong anthropogenic impact on them, even to the extent of converting the industrial enterprises to a zero-discharge water supply system. (Baker-FRC)
W83-02250

SURVEY, ECOLOGY, AND SYSTEMATICS OF THE UPPER POTOMAS ESTUARY BIOTA: AUFWUCHS MICROFAUNA - PHASE III,
Georgetown Univ., Washington, DC. Dept. of Biology.
D. M. Spoon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180281, Price codes: A02 in paper copy, A01 in microfiche. D. C. Water Resouces Research Center Report No 39, Univ. of the District of Columbia, July 1982. 35 p, 2 Fig, 15 Ref, 2 Append.

Descriptors: Bench scale models, Continuous flow system, *Organic pollution, Thermal pollution, Anabaena, Cladocerans, Daphnia, Ostracods, Copepods, Algal Blooms, Eutrophication, *Cyanophyta, Potomac River estuary, *Periphyton, District of Columbia, Zooplankton.

These studies utilized two adjacent bench scale rivers, each composed of four interconnected 24-gallon aquaria, stimulating summer flow and temperature (30 degrees C) of the fresh water estuarine Potomac River from Hains Point to Piscataway Creek. Initially all eight aquaria were seeded with the filamentous blue-green alga, Anabaena. To all aquaria was added a mixture of Daphnia, copepods, and ostracods from a swamp near Little Falls. (Preliminary studies showed these zooplankters could remove the Anabaena.) The experimental side received activated sludge from the Blue Plains Sewage Treatment Plant, while the control received dechlorinated tap water. Temperature, D.O., pH, phosphate, nitrate, and transmittance were determined. In experiment I, we obtained a pronounced algal bloom on the experimental side over the ten day run with reduction of zooplankters and their grazing. In experiment II, with sewage added to both sides, we used a heat shock of 10 degrees C in a bypass simulating the

conventional power plant on the experimental side causing decreased zooplankters and increased algal growth.
W83-02291

TOXAPHENE,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5B.
W83-02299

CALIFORNIA STATE MUSSEL WATCH: 1980-81, TRACE METALS AND SYNTHETIC ORGANIC COMPOUNDS IN MUSSELS FROM CALIFORNIA'S COAST, BAYS, AND ESTUARIES,
California State Dept. of Fish and Game, Monterey. Marine Bioassay Lab.
S. L. Coale, D. Smith, E. Armbrust, M. D. Stephenson, and M. Martin.
Water Quality Monitoring Report 81-11-TS, California State Water Resources Control Board, Sacramento, May 1982. 177 p, 104 Fig, 31 Tab, 89 Ref, 15 Append.

Descriptors: *Mussels, *Minerals, *Water quality, *Marine animals, Outfall sewers, Marine environment, Environmental effects, Water pollution effects, Marine biology, Water pollution sources, Ocean dumping, Water sampling, Organic compounds, Trace elements, Harbors, Bays, Coastal waters.

Since 1977 the State Mussel Watch (SMW) has monitored the accumulation of trace metal and synthetic organic compounds in marine mussels since they are good indicators of spacial and temporal distributions of toxicants. Part I of this report gives an overview of statewide conditions and a regionalized summary of the 1980-81 results. Silver, lead, zinc, PCBs and DDE were selected for comparison. Part II provides additional information on long-term trends of trace metals using baseline data from prior studies. The metals analyzed in mussel tissues included silver, aluminum, arsenic, cadmium, chromium, copper, mercury, manganese, lead, selenium and zinc. Mussels were transplanted to two open coast stations and 34 bay station during two time intervals. Aluminum, cadmium, copper, chromium, manganese, mercury and zinc appear to be detrimental to mussel reproduction as measured by the gonad index. Based on correlation analyses, aluminum, cadmium, copper, chromium, manganese, lead and zinc are suspected of having adverse affects on incremental growth. Part III is a follow-on analysis to the 1979 survey of synthetic organic compounds in mussels which showed substantial amounts of DDT compounds, PCBs, chlordane, dieldrin, heptachlor and endosulfan in certain areas. The 1980 study included intensive site surveys in San Francisco Bay, Los Angeles-Long Beach Harbor and San Diego Bay where higher trace metals and synthetic organic compounds had previously been measured. PCBs, dieldrin and endosulfan levels were about the same as in 1979. Chlordane levels were generally higher in urban areas. There is a greatly reduced rate of loss of DDT compounds as compared to the rate of decline in the early 1970s. (Atkins-Omniplan)
W83-02300

THE KELP FORESTS OF PALOS VERDES PENINSULA 1982,
California State Dept. of Fish and Game, Sacramento.
K. Wilson.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Southern California Coastal Water Research Project, Long Beach, CA., Willard Bascom, ed. p 67-70, 2 Fig, 11 Ref.

Descriptors: *Kelps, *Suspended solids, *Wastewater treatment, *Echinoderms, Sedimentation, Commerical fishing, Light penetration, Substrates, Secondary wastewater treatment.

The forests of giant kelp off Palos Verdes Peninsula provide food and shelter for many fish and invertebrates; however, the condition and size of the forests has fluctuated widely. In the mid-forties the forests began to deteriorate and by 1954 commercial harvesting was no longer feasible. In 1974 the kelp forests and associated biotic communities began to recover and approximately 700 acres existed by 1982, although this is much lower than the 1,800 acres measured in 1928. Solids in Los Angeles County's wastewater discharges contributed substantially to the decline and loss of kelp forests off the peninsula. Pinpointing which effects of the solids are the worst offenders is difficult. Among those suggested are: the siltation and burial of rocky surfaces by floc originating from plankton; reduction in depth of euphotic zone by suspended materials; high concentration of toxic chemicals; warm ocean temperatures from 1957 to 1959; and over grazing by sea urchins. Improved sewage treatment facilities since 1971 greatly reduced the discharge of suspended solids. Environmental changes improved the quality and quantity of light available for kelp growth and diminished substrate burial. Commercial harvesting of red sea urchins helped spur the return of kelp forests; however, unless purple and white sea urchins are harvested as well, restoration of the beds will remain unstable. Modern treatment facilities and techniques have reduced suspended solids levels to that of 1956. A high-intensity kelp restoration program along with continued improvements in sewage treatment facilities will do much to enhance the kelp forest habitat and associated marine resources. (Atkins-Omniplan)
W83-02304

SANTA MONICA BAY PLANKTON DISTRIBUTION,
University of Southern California, Los Angeles. Allan Hancock Foundation.
G. Kleppel, E. Manzanilla, B. Teter, and S. Petrich.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Southern California Coastal Water Research Project, Long Beach, CA., Williard Bascom, ed. p 71-84, 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Zooplankton, *Nitrogen, *Nitrates, *Wastewater disposal, *Ammonium, Outfall sewers, Water sampling, Ocean circulation, Euphotic zone, Vertical distribution, Advection, Distribution patterns, Flourescence.

Phytoplankton can be indicative of eutrophication and contamination in estuaries, but is less definitive in open coastal waters. The author's objectives were to determine of phytoplankton abundance and composition near the Hyperion 5-mile outfall differed from that along an onshore-offshore transect in the bay, and to determine if plankton and nutrient distributions were influenced by wastewater discharge. During 1980, monthly samples were taken at nine stations. The results suggest that several nitrogen sources drive phytoplankton growth and distribution in the bay. Nitrate enters the euphotic zone by vertical diffusion and possibly by horizontal advection from the Santa Barbara Channel. Ammonium in the bay may be from discharge from marinas, nearshore outfalls, or recycling by animals and bacteria. Not surprisingly, nitrate and ammonium levels were usually higher near the bottom of the euphotic zone than at the surface, suggesting that light intensity could influence phytoplankton growth. Nitrogen from the 5-mile Hyperion outfall was rarely detectable in the euphotic zone. Nothing unusual was detected in net phytoplankton abundance, distribution, or composition in the outfall's vicinity. Zooplankton abundance at the outfall station was higher than elsewhere along the transect but defining the process (growth, entrainment, migration) reponsible was nearly impossible. Several hypotheses need to be tested regarding the cause of the peak, i.e., that waste discharge causes an elevation in primary production which is grazed down by the zooplankton, and/or that zooplankton feed on materials in the wastefield directly. (Atkins-Omniplan)
W83-02305

AN ADVANCED SEDIMENT-QUALITY MODEL,
Southern California Coastal Water Research Project Authority, Long Beach.
T. Hendricks.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 247-257, 6 Fig.

Descriptors: *Model studies, *Municipal wastewater, *Outfall, *Sedimentation rates, *Coastal waters, Marine sediments, Suspension, Bathymetry, Distribution patterns, Benthic environment, Effluents, Particulate matter, Water depth, Current meters.

To estimate the effects of a new outfall, or to estimate changes as a result of modified treatment, a numerical model was developed to simulate the processes which determine the properties of the sediments. A sedimentation sub-model estimated the sedimentation fluxes and patterns in both the Palos Verdes and Newport Beach outfall areas. Hypothetical outfalls, of identical design and wastewater characteristics, were created at both sites to see if either could better minimize the effects on the benthos. The sedimentation rate around Newport Beach would be about half that off of the Palos Verdes. However, since the currents are different at each site, it is not clear whether the differences are due to bathymetric variations or to differences in currents, but the results suggest that slightly more than half of the increased flux of particulates in the Palos Verdes area is related to the bathymetry, with the remainder associated with currents. Other processes included in the model are the sedimentation of natural particulates, resuspension and redistribution of sediments, bioturbation, and simple forms of biological decompositon and chemical mobilization of trace consitituents in the sediments. The first three parameters will be determined by comparing the predicted charcteristics of the sediments in the Palos Verdes area with observed characteristics in cores from a joint Los Angeles County and SCCWP Study. Further model testing will compare predicted and observed characteristics at 3 or 4 other outfall sites and the results described in a future report. These sites cover a wide range of suspended solids mass emission rates. The outfalls discharge in water depths of 20 to 56 meters. (Atkins-Omniplan)
W83-02308

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES III HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS (MOSSEL BAY),
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W83-02376

INDIA'S WATER BORNE DISEASES--A CHALLENGE,
Minor Irrigation Dept., Lucknow (India).
A. C. Chaturvedi.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 62, No 2, p 37-42, February, 1982. 1 Tab, 14 Ref.

Descriptors: *Diseases, *Public health, *Developing countries, Human diseases, *India, Water pollution effects, Bacteria, Water supply, Research priorities.

The widespread incidence of waterborne disease in India is a result of contamination of water supplies with infectious agents and excessive quantities of inorganic ions. Studies have indicated that increased water hardness promoted human health and that Himalayan peoples drinking pure mountain water had a lower cancer mortality rate than persons drinking polluted waters. Cholera, olter stram, hepatitis, parasitic diseases, and other health problems affect a large proportion of the population and retard national progress. Of Bombay's 7 million inhabitants, half have suffered clinical or sub-clinical jaundice. The problems of rural water supplies are as yet undefined. No long range plans, finances, or institutional framework exist to study the problems. Most development of water testing equipment has been concentrated in cities. There is a great need to develop simple testing and treatment units for the rural areas, for training programs, and for epidemiological studies. (Cassar-FRC)
W83-02386

THE EFFECT OF ENVIRONMENTAL FACTORS ON THE SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
Liverpool Polytechnic (England). Dept. of Biology.
D. Nuttall.
Journal of Applied Bacteriology, Vol 53, No 1, p 61-71, 1982. 5 Tab, 22 Ref.

Descriptors: *Bacteria, *Organic matter, *Temperature, *Heterotrophic bacteria, Dee River, *Wales, Water temperature, River flow, Particulate matter, Multivariate analysis, Water quality, *Regression analysis, Rivers, Sampling, Data collections.

Water samples collected every 8 days from 3 sites (upper, middle, and lowland) on the Welsh River Dee during 1975-76 were analyzed for physical, chemical, and biological variables and heterotrophic bacteria activity. Bacterial population estimates were regressed on 21 independent environmental variables using multiple linear regression analysis. Prediction equations calculated for the 1975-76 data accounted for 70% of the total variation for the upland site and 40% for the lowland site. Data from 1977-78 were used to examine the validity of the 1975-76 data. Correlations of bacterial plate count values were significant for the upper and middle reaches but not for the lowland reach. The direct count correlation was significant for all 3 sites. Permanganate value, a measure of organic matter, was the most dominant variable and was shown by principal component analysis to be linked to particulate matter and river flow. The logarithm of the heterotrophic potential for the lowland site was a linear function of temperature. A specific activity index calculated for the lowland site data gave a median value of 8.4 times 10 to the minus 10th power micrograms per hour per bacterial cell; it was highly sensitive to temperature change. The upland site specific activity index was 2.6 times 10 to the minus 10th power micrograms per hour per bacterial cell and did not respond significantly to temperature change. (Cassar-FRC)
W83-02402

SOME EFFECTS OF VOLCANIC ASH ON PLANKTON PRODUCTIVITY,
Washington State Univ., Pullman. Dept. of Zoology.
R. A. Parker, and A. J. Gaddy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187179, Price codes: A02 in paper copy, A01 in microfiche. Washington Water Research Center Completion Report, Washington State Univ., Pullman, February 1983. 19 p, 13 Tab, 20 Ref. OWRT C-10049(1441)(1).

Descriptors: Photosynthetic, *Ash, Carbon-14, Carbon, *Zooplankters, Grazing activity, *Planton productivity, *Washington, Mt. St. Helens, *Cyclotella, *Cryptomonas, *Diaptomus, *Daphnia, Water pollution effects.

Experiments were conducted to determine the effects of soluble and particulate fractions of Mt. St. Helens ash on carbon-14 uptake by Cyclotella and Cryptomonas. Cyclotella demonstrated reduced photosynthetic activity in the presence of filtrate, and ash suspensions increased carbon fixation by Cryptomonas. In addition, the effects of particulate ash on feeding and assimilation by Diaptomus and Daphnia were measured. When fed Cryptomonas together with ash, grazing activity by both zooplankters was not affected. On the other hand, when fed Cyclotella with small amounts of ash, Daphnia ingested more algae whereas Diaptomus did not. Also, ash interfered with the assimilation of carbon-14 by Daphnia from ingested Cyclotella.
W83-02410

MICROBIAL UPTAKE OF CADMIUM AND ITS EFFECTS ON THE BIOCHEMICAL OXYGEN DEMAND AT VARIOUS TEMPERATURES,
Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W83-02414

5D. Waste Treatment Processes

PHOTOCATALYTIC OXIDATION OF ORGANIC POLLUTANTS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
G. L. Schrader, and M . M. Hwang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173179, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Univ. of Delaware, Newark, December 1982. 27 p, 8 Fig, 3 Tab. OWRT A-042-DEL(2), 14-34-0001-9008.

Descriptors: Industrial wastes, *Photooxidation, *Wastewater oxidation, *Phenols, *Catalysts, *Wastewater treatment, Stream pollution, *Organic acids, *Organic wastes.

The photooxidation of phenol in aqueous solution with several catalysts was studied in a batch-recycle reactor at 65C and atmospheric pressure. The tubular reactor was irradiated with a polychromatic ultraviolet lamp located at a focus of an elliptical reflector. Different metal nitrate salts were used as catalysts, including nickel nitrate, cobalt nitrate, ferric nitrate, manganese nitrate, cerium nitrate and lanthanum nitrate. Liquid samples from the photoreactor were analyzed by gas chromatography for phenol concentration. The presence of cations of catalysts were determined by ultraviolet spectroscopy. The ferric nitrate was the most active catalyst. The initial rate of phenol decomposition was in first order with respect to phenol concentration for all catalysts.
W83-02126

UTILIZATION OF MOLECULAR OXYGEN AND SUNLIGHT IN THE OXIDATIVE PURIFICATION OF WATER,
West Virginia Univ., Morgantown. Water Research Inst.
W. R. Cherry, and B. P. Jessen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173252, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, 1982. 16 p, 4 Fig, 5 Tab, 15 Ref. OWRT A-042-WVA(1), 14-34-0001-1152.

Descriptors: *Chlorinated hydrocarbons, *Irradiation, *Oxidation, *Photoactivation, *Solar radiation, *Wastewater treatment, *Water treatment, Catalysts, Chemical degradation, Industrial wastes, Organic compounds, Oxygen, Phenols, Photosynthesis, Pollutants, Polymers.

The study was directed toward obtaining knowledge that could be used in developing new, better, and less costly methods for treating wastewater and drinking water without producing harmful substances. Oxidation of several chlorinated phenols by singlet oxygen was investigated. The two main products resulting from the oxidation of orthochlorophenol were isolated and characterized. The kinetics for the oxidation of ortho-, meta-, and parachlorophenol were determined in methanol and in water. Pentachlorophenol was oxidized in the same way as the monochlorophenols. Rose bengal was used as the sensitizer. The sensitizer was bound to hydrophilic-polymer beads to prevent the dye from contaminating the water. The method is very effective in oxidizing chlorinated phenols. The aromatic ring is destroyed and the chlorine becomes an inorganic chloride ion. The rates are practical for treatment even at the low concentrations of chlorinated phenols commonly contained in polluted water-supply sources. The rate for pentachlorophenol is faster than those for the monochlorophenols. Pentachlorophenol was completely decomposed in three hours. The process is satisfactory as a basis for research and development of a new wastewater and water-supply treatment method.
W83-02134

PERMITTING OPTIONS AND DESIGN PROCEDURE FOR A CONTROLLED-DISCHARGE WASTEWATER TREATMENT FACILITY,
Georgia Univ., Athens. Inst. of Natural Resources.
K. J. Hatcher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175265, Price codes: A07 in paper copy, A01 in microfiche. Environmental Resources Center Report No ERC 06-82, Atlanta Georgia Institute of Technology, August 1982. 120 p, 9 Fig, 11 Tab, 24 Ref. OWRT A-087-GA(1), 14-34-0001-0111.

Descriptors: *Wastewater treatment, Discharge permits, Water quality, *Mathematical models, Cost minimization, *Oxidation, Oxidation pond, Lagoons, Effluent, Effluent storage, *Land application, Facilities, Facility upgrading, Computers, Computer software, *Risks, Wastewater treatment plants.

A wastewater treatment facility with a controllable discharge rate can meet stringent stream quality standards at a lower treatment cost than a conventional facility. This research project examines permitting and design procedures for a controlled-discharge treatment facility, which has a wastewater storage pond and/or land application site added to a conventional primary or secondary treatment facility. The facility's discharge rate to the receiving stream is controlled to match the stream's daily or seasonal flow and waste assimilative capacity, and the discharge rate to the land application site (if one is used) is also controlled. To realize any cost savings, a controlled-discharge facility requires a new type of 'hydrograph-controlled' discharge permit to allow the facility to discharge a higher waste load during higher streamflow periods. Since the usual '7-day, 10 year' minimum stream flow condition can't be used in determining waste load limitations for a hydrograph-controlled permit, risk-based permit criteria are proposed for different design drought hydrographs. Four types of hydrograph-controlled permit criteria are described and evaluated in terms of treatment cost savings, stream quality protection, and 'ease of use' as compared to a conventional permit for a constant discharge facility. This report develops a generalized facility simulation model and an optimization method for quickly determining the least cost facility design and discharge schedule.
W83-02181

ANAEROBIC TREATMENT OF PULP AND PAPER WASTES,
ADI Ltd., Fredericton (New Brunswick).
A. A. Cocci, R. C. Landine, T. Viraraghavan, and G. J. Brown.
Pulp and Paper Canada, Vol 83, No 9, p 70-73, September, 1982. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Pulp and paper industry, *Pulp wastes, Industrial wastes, White water, Kraft mills, Sulfite liquors, Anaerobic conditions, Financial aspects.

The use of anaerobic treatment of pulp and paper wastes in most situations can offer decided capital and operating cost savings when compared to an aerobic system of equivalent design. The theory of anaerobic treatment and trends in the field are reviewed, along with several of the anaerobic treatment processes available. The major advantages of anaerobic treatment are identified, and the results from laboratory, pilot and full-scale anaerobic systems treating a number of different pulp and paper waste streams are summarized. (Baker-FRC)
W83-02189

PACKED-BED REACTORS FOR CONCENTRATED-WASTE TREATMENT AND ENERGY PRODUCTION,
Puerto Rico Univ., Mayaguez. Dept. of Mechanical Engineering.
K. B. Pedersen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177998, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Waters Resources Research Institute Completion Report, Mayaguez, 1983. 97 p, 19 Fig, 13 Tab, 46 Ref, 1 Append. OWRT A-052-PR(1), 14-34-0001-9041.

Descriptors: *Anaerobic digestion, *Digestion equipment, Domestic wastes, Organic loading, Methane bacteria, *Puerto Rico, *Wastewater treatment, Energy production, Filter processes.

The objective of this research project was to study the design parameters of the anaerobic filter process such as organic loadings and hydraulic retention time, and the response of the process in relation to organic matter removal and energy production for a typical condition in Puerto Rico. The organic loading was found to be a very important parameter during the operation of the anaerobic filter. The activity of the filter in removing organic matter evidenced the dependence on the applied organic loading. The continuous variations of the organic loading rates and the considerably high magnitude of such loads in addition to the high concentration of suspended solids could result in dynamic fluctuations between the individual waste components affecting the steady state condition of the organic conversion process causing that none of the three conditions studied have shown a significant improvement in the organic removal and in the gas production rate. However, occasional COD and TSS removals of 55% and 68%, respectively, were observed at the first flow rate condition of 92 l/d (24.3 gal/d). The portion of the influent COD remaining in the filter effluent was inversely proportional to the theoretical hydraulic retention time for a range of 5.1 to 10 hours. Therefore, the hydraulic retention time was the most important operating parameter of the anaerobic filter. (Munoz, Puerto Rico)
W83-02214

ADDITIONAL TREATMENT OF WASTEWATERS TO REMOVE NITROGEN COMPOUNDS IN AERATED OXIDATION PONDS,
Nauchno-Issledovatel'skii Inst. Kommunalnogo Vodosnabzheniya i Ochiski Vodi, Moscow (USSR).
L. I. Gyunter, E. V. Grebenevich, V. A. Vavilin, and V. B. Vasil'ev.
Water Resources (English Translation), Vol 9, No 1, p 104-109, January/February, 1982. 4 Fig, 1 Tab, 4 Ref. Translated from Vodnye Resursy, No 1, p 154-159, January-February, 1982.

Descriptors: Population dynamics, *Primary productivity, *Algae, *Oxidation ponds, *Wastewater treatment, Oxidation, Daphnids, Nitrogen, *Denitrification.

To determine the possibility of raising cladocerans on biologically treated wastewater containing microalgae, experimental investigations were carried out, and a mathematical model of the dynamics of the change in the population of daphnids was also developed. Experiments on determining the effect of various concentrations of green algae on the development and productivity of daphnids were carried out simultaneously with five concentrations of algae. The best conditions for development of the daphnid culture were created in a medium with an algal concentration of 150-300 mg/liter. The results of the study of dynamics of the increase of biomass of the zooplankton at various algal concentrations indicate that both the rate of increase and the maximum concentration of the daphnid culture depend on the algal concentration. (Baker-FRC)
W83-02241

ANAEROBIC TREATMENT OF WASTEWATER: THE GAS-LIQUID-SLUDGE SEPARATOR,
Centraal Inst. voor Industrietontwikkeling, The Hague (Netherlands).
R. R. van der Meer, and R. de Vletter.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1482-1492, November, 1982. 8 Fig, 5 Tab, 26 Ref.

Descriptors: *Sludge solids, *Separation techniques, *Foam separation, Settling, *Wastewater treatment, Anaerobic digestion, Digestion, Anaerobic upflow reactors, Plug flow, Laminar flow.

An integral gas separator-settler combination was designed to control the quantity of sludge leaving an anaerobic upflow reactor. First the influent, containing gas, liquid, and solid phases, is separated from the recirculating stream. After separation of gas, the suspension of solid matter and liquid loses dissolved gases in an expansion chamber. Finally sludge is separated in the settling compartment where laminar flow exists. As the sludge blanket is formed, it sinks back into the reactor through openings in the bottom plates, which are situated at an angle of 45 degrees. Studies were performed on reactors with volumes of 6, 30, and 200 cu m using acidified sugar factory wastewater (COD, 1300-2600 mg per liter) and by-products wastewater (COD, 7000-17,000 mg per liter). Solids separation efficiences were 96-99.5% at suspended solids concentrations up to 40 kg per cu m at the inlet to the settler. The fluid flow patterns varied with process conditions: regions of plug flow and regions of good mixing at low sludge concentrations in the sludge blanket, laminar flow at low gas production rate, and some dead space in the reactor and settler at high sludge concentrations. (Cassar-FRC)
W83-02258

REMOVAL OF TOXIC METALS FROM POWER-GENERATION WASTE STREAMS BY ADSORPTION AND COPRECIPITATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, K. F. Hayes, and J. O. Leckie.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1472-1481, November, 1982. 16 Fig, 3 Tab, 23 Ref.

Descriptors: *Trace metals, *Adsorption, *Iron hydroxide, *Wastewater treatment, Industrial wastewater, Metals, Powerplants, *Chemical precipitation, Fly ash, Hydrogen ion concentration, *Ions, Anions, Cations.

Adsorption/coprecipitation of ions commonly found in coal-fired power-plant wastes onto amorphous iron oxyhydroxide were studied using a mathematical model and experiments with actual wastes. pH was the primary factor controlling adsorption; increasing pH increased adsorption of cations and decreased adsorption of anions. To a lesser extent adsorption was affected by adsorbent concentration, concentration of other ions (especially copper) in solution, and complexing ligands. Adsorption of trace contaminants was similar in both the complex natural waste and the simpler synthetic waste. The stronger pH effect in synthetic waste was probably a result of competitive adsorption interaction and complexation by dissolved ligands. An acid metal cleaning waste proved suitable as the iron source for copreciptation. Ions included Zn, Cd, Cu, selenite, arsenite, and chromate. (Cassar-FRC)
W83-02260

LOW TEMPERATURE ANAEROBIC BIOFILTRATION IN UPFLOW REACTORS,
Duncan, Lagnese and Associates, Inc, Pittsburgh, PA.
J. A. Oleszkiewicz, and S. Koziarski.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1456-1471, November, 1982. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Anaerobic digestion, *Biofiltration, *Animal wastes, *Wastewater treatment, Hogs, Kinetics, Anaerobic upflow reactors.

An anaerobic biofilter, operated in an upflow mode, was used to treat dilute animal wastes on a pilot scale. Operating parameters were: temperature, 23-26C; organic loading, 0.4-6.55 kg COD per cu m per day; hydraulic retention time, 14-343 hours. Nonfiltered COD removals were 70-93%. Effluent with nonfiltered BOD of 210-1400 mg 02 per cu dm produced influent with nonfiltered COD of 9050-10500 mg 02 per cu dm and nonfiltered BOD of 4000 mg 02 per cu dm. Gas production increased gradually with increasing loading; average daily methane production was 0.024-0.171 cu m per kg COD removed. The optimum gas production was about half the maximum theoretical value of 0.35 cu m methane per kg COD removed at loadings of 3-4 kg COD per cu m per day. Removals of nitrogen were 30-50% total Kjeldahl N and 52-72% organic N. Optimum operating conditions were: loading, 3-4 kg COD per cu m per day; hydraulic retention time, 24 hours; effluent nonfiltered COD, 1500 mg 02 per cu dm; and 0.16 cu m methane per kg COD removed. (Cassar-FRC)
W83-02261

KINETIC ANALYSIS OF ALTERNATIVE CONFIGURATIONS FOR SINGLE-SLUDGE NITRIFICATION/DENITRIFICATION,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1493-1504, November, 1982. 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrification, *Denitrification, *Biological treatment, *Kinetics, *Wastewater treatment, *Single-sludge systems, Anaerobic treatment, Aerobic treatment, Oxidation, Model studies, Mathematical models.

A computer simulation model was developed to aid in the analysis of single-sludge wastewater treatment systems for biological nitrification/denitrification. Simulation of the intermittently aerated completely mixed (IACM) configuration showed the importance of 2 new process variables, aeration fraction and cycle time ratio. The aeration fraction, which represents the relative activity of the aerobic and anaerobic microbial reactions, determines the relative amounts of nitrate and ammonia in the effluent organic matter concentration. The cycle time ratio represents the degree of non-steady-state conditions caused by intermittent aeration. Lower cycle time ratios produced significantly lower effluent nitrogen concentrations. A simplified first-order kinetic model was used to evaluate alternative reactor configurations for single-sludge systems. As the cycle time ratio decreased, all of the reactor configurations could be described as completely mixed basins with kinetic coefficients averaged over aerobic and anaerobic cycles. This method is applicable to other configurations operated at low cycle time ratios. Simple procedures are given for analysis of three configurations: IACM, the series of completely mixed basins with recycle, and plug flow reactors with intermittent aeration and mixed liquor recycle. (Cassar-FRC)
W83-02262

ANAEROBIC TREATMENT OF THERMAL CONDITIONING LIQUORS,
Gore and Storrie Ltd., Toronto (Ontario). Wastewater Projects Div.
For primary bibliographic entry see Field 5E.
W83-02282

COST INDEX TRENDS AND COMPARISONS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6C.
W83-02285

ALGAL AVAILABILITY OF PHOSPHORUS IN MUNICIPAL WASTEWATER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, J. V. DePinto, S. E. Flint, M. S. Switzenbaum, and J. K. Edzwald.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1505-1516, November, 1982. 11 Fig, 5 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Wastewater composition, Model studies, Bioassays, Nutrients, Wastewater treatment, Fate of pollutants, Municipal wastewater, New York, Minnesota.

Scenedesmus sp bioassays of wastewater influent, effluent, and an intermediate process collected from 4 wastewater treatment plants in the Great Lakes area indicated that short-term (14-day) availability of soluble phosphorus (82%) was significantly greater than that of particulate P (55%). Total short-term available P averaged 72% of total

wastewater P. Analysis of the short-term data by a first order model showed that 100% of the soluble P and 63% of particulate P were ultimately available for algal uptake. Rates at which both fractions become available were 0.27 per day. The type of treatment (activated sludge, combinations of chemical additions, aeration, trickling filter, etc.) did not affect P availability. P availability decreased with treatment by 70-96%, except in one plant using a split stream of 80% conventional activated sludge and 20% primary treatment with alum and polymer. Available P was not selectively removed by the treatments covered in this study. This nonselectivity was unaffected by influent concentration (2.4-7 mg per liter), physical form of influent P (40-75% particulate), or type of treatment. Since soluble P is much more bioavailable on the short-term, treatment methods to minimize this component are preferable. (Cassar-FRC)
W83-02286

THERMODYNAMIC EVALUATION OF WATER POLLUTION CONTROL PROCESSES,
Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
R. Munoz-Candelario.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181966, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, Puerto Rico Water Resources Research Institute, Mayaguez, March 1983. 18 p, 2 Fig, 2 Tab, 7 Ref. OWRT A-058-PR(1), 14-34-0001-9041.

Descriptors: *Thermodynamics, Efficiences, *Wastewater treatment, *Entropy, *Energy losses, Heat, Activated sludge process, Trickling filter system, Water pollution control.

A thermodynamic analysis of the processes used to control water pollution shows that absolute values of their true thermodynamic efficiences can not be determined either experimentally or analytically. It is demonstrated that for processes achieving the same degree of purification on a given wastewater, the true thermodynamic efficiences increase as the respective energy requirements decrease. The practical thermodynamic efficiency of the activated sludge process was found to be lower than that of the trickling filter system for the treatment of municipal wastewaters. For capacities from 0.1 to 5.0 mgd, the values for the activated sludge process ranged from 63.9 to 69.7%, while those for the trickling filter operation varied from 69.4 to 70.3%.
W83-02322

BENEFITS FROM JOINT TREATMENT OF MUNICIPAL AND POULTRY PROCESSING WASTEWATER,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
D. J. Epp, C. E. Young, and D. Rossi.
Water Resources Research, Vol 18, No 5, p 1587-1590, October, 1982. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Poultry wastes, *Food processing plants, Filters, Cost analysis, Municipal wastewater.

This paper presents results of research on the costs of joint and separate treatment of wastewater by small rural communities and poultry-processing plants. Three sizes of poultry processing plants (51,000 to 207,000 birds per day) and sizes of communities (3,000 to 20,000 people) were studied and costs were developed for lagoon, activated sludge, and trickling filter systems. Lagoon systems were cost effective for both separate and joint treatment. Trickling filter systems cost less than activated sludge systems when only domestic wastes are treated. The reverse is true when poultry processing wastes are introduced. When activated sludge or lagoon treatment is used, joint treatment gives a substantial cost saving for any size of poultry processing plant, regardless of community size. The potential savings from joint treatment are sufficient to pay for up to 6 miles (9.6 km) of gravity main transmission of poultry processing plant wastes to a municipal treatment plant. (Baker-FRC)
W83-02333

OXIDATION OF BIOLOGICAL SLUDGES WITH OZONE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and S. Akhlaque.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 609-637, 1982. 14 Fig, 2 Tab, 11 Ref.

Descriptors: *Activated sludge, *Sludge conditioning, *Ozonation, *Bottom sediments, Hydrogen ion concentration, Alkalinity, Digested sludge, Chemical oxygen demand, Heavy metals, Oxidation, Sludge disposal.

Sludge disposal problems can be alleviated by reducing the volumes of sludges following biological digestion, principally via improved dewatering. The effects of using ozone as a conditioning and oxidizing agent on the pH, alkalinity, heavy metal release and chemical oxygen demand (COD) of sludges were examined in a return activated sludge, a thickened sludge, an anaerobically digested sludge, and lake bottom sediments (control sludge). After ozonation in a glass batch reactor, heavy metals were released from the sludges. As a result of ozonation, odor was completely eliminated, dissolved COD increased and total COD was considerably decreased. Ozone-treated sludge showed increases in alkalinity and improvements in color. Upon ozonation, the pH of the return activated sludge increased from 6.7 to 6.9 then remained stable and later decreased to 5.9. The pH of the digested sludge increased from 7.3 to 8.1 and the thickened sludge followed the same trend. The pH of the sludge from the lake bottom remained almost neutral throughout ozonation. (Geiger-FRC)
W83-02334

THE EFFECTS OF LOW DISSOLVED OXYGEN TENSION DURING THE AEROBIC TREATMENT OF PIGGERY SLURRY IN COMPLETELY MIXED REACTORS,
West of Scotland Agricultural Coll., Auchincruive. Dept. of Microbiology.
M. P. W. Smith, and M. R. Evans.
Journal of Applied Bacteriology, Vol 53, No 1, p 117-126, 1982. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Animal wastes, *Dissolved oxygen, *Nitrification, *Wastewater treatment, Manure, Oxygen, Aerobic treatment, Denitrification, Ammonia, Nitrogen, Bacteria, Sewage bacteria, *Piggery wastes.

The effects of low dissolved oxygen (DO) concentrations during treatment of piggery wastes in an aerobic reactor were studied. At 15C the removal of carbonaceous material was the same over the range of 0.1 to 40% saturation. However, below 15% of oxygen saturation the quantity of input N which remained in the slurry was directly proportional to the average DO level. The organic N (or nonconvertible) fraction was unaffected was unaffected by DO levels and stayed near 800 mg per liter over the 3.5-10 day range of residence time. However, the ammonia-N (or convertible fraction) remaining in the slurry was directly proportional to the average DO and DO levels $<$ 15% saturation. Up to 45% of total input N and up to 85% of convertible N could be lost at low DO levels. This loss was a result of nitrification-denitrification. Low DO levels favored nitrification because denitrifying bacteria raised the pH to favorable levels. Control of pH at 7.1 reduced the variability of nitrification-denitrification and produced complete oxidation of ammonia even at low DO levels. (Cassar-FRC)
W83-02335

POTENTIAL OF ALGAL PRODUCTION,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
J. U. Grobbelaar.
Water SA, Vol 8, No 2, p 79-85, April, 1982. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Algal growth, *Biomass, *Oxidation ponds, *Chlorophyta, *Mathematical models, Aquatic productivity, Oxidation process, Model studies, Water temperature, Light intensity, Water depth, South Africa.

Mass algae cultivation has been carried out for purposes of food production, waste treatment, and bioenergy conversion. The best results with mass algal culture have been in the field of sanitary engineering, where algae are used to treat wastewater in oxidation ponds. Dense open outdoor cultures of algae are prone to infections and parasitism, especially by protozoa and rotifers, which can affect the yield and quality of the biomass. A mathematical model has been developed, calibrated and verified in a study to optimize algal production rates. The model takes into account the effects of light intensity, depth, and water temperature on the rate of biomass growth. The model may be used in predicting optimal biomass concentrations for use in outdoor algal ponds. (Geiger-FRC)
W83-02374

SELECTION OF ALGAL SPECIES FOR USE IN OUTDOOR MASS CULTURES,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
M. M. J. Van Vuren, and J. U. Grobbelaar.
Water SA, Vol 8, No 2, p 86-91, April, 1982. 7 Fig, 21 Ref.

Descriptors: *Wastewater treatment, *Algal growth, *Light intensity, *Algae, Nutrients, *Chlorophyta, *Water temperature, Biomass, Model studies, Scenedesmus, Chlorella, Mathematical models, South Africa.

Algae have been grown by mass cultivation techniques for use in food production, waste treatment, and bioenergy conversion. The criteria used to select an alga for each application are based on general characteristics such as growth rates, harvestability, resistance to predation and infection, and specific characteristics which apply to the intended application. For food production, high protein content, good digestibility, and favorable amino acid content are important. For the treatment of wastes, algae must have a high nutrient uptake capability, the possibility of heterotrophic growth, tolerance of low oxygen levels and good resistance to bacterial contamination. For bioenergy conversion, algae should possess a high carbohydrate content and low rates of respiration and organic excretion. Test were conducted on Scenedesmus bijugates and Chlorella species to determine the response of these algae under different temperatures, light intensities and nutrient supplies in terms of growth rates, activation energy, yield coefficients, half-saturation constants and protein contents. These preliminary tests are being studied for use in a larger program to classify algal strains according to their possible utilization, and for use in establishing parameters for mathematical model building. (Geiger-FRC)
W83-02375

TREATABILITY ANALYSIS OF DIGESTER SUPERNATANT AND OTHER RETURN FLOWS TO IMPROVE WASTEWATER TREATMENT PLANT EFFICIENCY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer, and D. F. Lawler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187187, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 182, Univ. of North Carolina, Raleigh, July 1982. 122 p, 37 Fig, 23 Tab, 20 Ref. OWRT A-089-NC(1), 14-34-0001-7070.

Descriptors: *Sludge digestion, *Wastewater treatment, *Sludge dewatering, Dewatering, *Return flow, *Anaerobic digester supernatant, *Anaerobic digestion.

The significance of return flows from anaerobic digesters and sludge dewatering devices was assessed at five municipal wastewater treatment plants. Digester supernatant was found to represent an important waste load being returned to the

main wastewater treatment processes for several pollutants of interest, notably suspended solids, nitrogen and phosphorus. Inefficient solid-liquid separation in the digesters, due to both design and operating limitations, was found to be the major cause of this situation. Waste flows from sludge dewatering facilities were less significant due to better solid-liquid separation. Laboratory treatability studies conducted on anaerobic digester supernatant indicated that chemical treatment of the supernatant prior to its return to the plant influent could markedly improve its quality, but that such treatment is not necessary if good solid-liquid separation in the digesters could be achieved. The results suggest that substantial improvements both in the design and operations of sludge digesters and subsequent dewatering processes are needed to alleviate the problems associated with the return of digester supernatant. Such improvements are discussed.
W83-02411

THE APPLICATION OF DEVELOPMENTS IN ANAEROBIC DIGESTION WITHIN SEVERN-TRENT WATER AUTHORITY,
Severn-Trent Water Authority (England). Lower Trent Div.
C. E. Brade, G. P. Noone, E. Powell, H. Rundle, and J. Whyley.
Water Pollution Control, Vol 81, No 2, p 200-219, 1982. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Detention time, *Wastewater facilities, *Operating costs, *Capital costs, Digestion, Wastewater treatment, Digested sludge, Sludge, Cost analysis, *England, Severn-Trent Water Authority.

In 1975 and 1976, surveys of Severn-Trent Water Authority digestion plants were carried out. Results of these evaluations indicated a need for greater definition of process design parameters. A Sludge Digestion Studies Group was formed to monitor progress on projects focussing on the effects of reduced detention period, methods of sludge mixing and heating, techniques of sludge feeding, and construction of digestion tanks and conversion of existing tanks. The basic process design requirements are reviewed, along with operations at the Mansfield, Shirebrook and Pitts Mill plants, which exemplify three different ways of meeting some of these requirements. The digester at Mansfield was uprated by installing new process equipment. The large size of the Mansfield operation along with the remaining life of the tank and pumphouse structures helped to maintain low unit capital costs. In order for the smaller Shirebrook plant to realize an operating costs savings, gas collection and storage would have to be conducted to reduce fuel costs. The Shirebrook unit was also uprated by installing new process equipment. In contrast, the rural Pitts Mill plant is a small and expensive prefabricated complete digestion package. The construction of new digestion plants of shorter design detention period coupled with improved process equipment and more sophisticated control equipment is resulting in an overall reduction in cost and an increase in reliability. Lengthy discussion of these works, replies to the discussion and some appendices are included. (Geiger-FRC)
W83-02413

LOW-COST PROVISION OF ANAEROBIC DIGESTION: II. HIGH-RATE AND PREFABRICATED SYSTEMS,
Severn-Trent Water Authority, Birmingham (England).
G. P. Noone, and C. E. Brade.
Water Pollution Control, Vol 81, No 4, p 479-510, 1982. 16 Fig, 11 Tab, 30 Ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Process control, Digestion, Retention time, Performance evaluation, Monitoring, Design criteria, Costs, Capital costs, Biological treatment, Sludge treatment.

A progress report is presented on continuing studies of low cost anaerobic sludge digestion systems. Revised interim design parameters are: 15 days maximum retention at 35C, a minimum feed sludge solids of 4%, a minimum tank aspect ratio of 1, a minimum floor slope of 45 degrees, a maximum power of 5 W per cu m, and a mixing volume of 0.00647 N cu m per sq m per min. Two designs of low cost digesters were described. One used process equipment designed for other industries; the other used prefabricated structures. The cheapest and most reliable indicators of digester performance were odor and appearance, gas volume, gas quality, volatile/total acids ratio, and propionic acid level. Effective and stable digestion at full scale was possible with retentions as low as 7.5 days and loadings as high as 6.5 kg DOM per cu m per day. Remaining possibilities for reducing the cost of anaerobic digestion are increases in feed sludge concentration, additional use of prefabricated structures, direct steam heating reducing capital costs, and reducing corrosion of gas collection and storage structures. (Cassar-FRC)
W83-02424

MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION,
For primary bibliographic entry see Field 5G.
W83-02425

APPLICATION OF CRYO-CUT METHOD FOR MEASUREMENTS OF BIOFILM THICKNESS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
G. H. Kristensen, and F. P. Christensen.
Water Research, Vol 16, No 12, p 1619-1621, December, 1982. 4 Fig, 9 Ref.

Descriptors: *Biofilms, *Microscopic analysis, *Cryo-cut method, *Wastewater treatment.

The cryo-cut method is used to measure the thickness of biofilm in a laboratory-scale reactor. Very thin waterproof, transparent tape installed in the reactor accumulates biofilm. For measuring the biofilm thickness, a bit of tape is cut off and imbedded in Tissue-Tek in a cryo-cut microtome at -25C. Slices 50-150 microns thick are cut and photographed in an interference contrast microscope. Examination of biofilms subjected to a pH rise showed a dense layer (calcium phosphate) in the rear part of the biofilm. This zone disappeared upon the addition of a few drops of 10% acetic acid. In another experiment, the flocs found in fluidized bed reactors were demonstrated to be hollow, a result of the decompositon of the innermost organisms. (Cassar-FRC)
W83-02426

REDUCTION IN CHLORINE REQUIREMENTS BY CONTROL OF NITRIFICATION IN AN OXYGEN ACTIVATED SLUDGE PROCESS,
Houston Univ., TX.
J. V. Matson, J. F. Andrews, and M. T. Garrett.
Water Research, Vol 16, No 7, p 1083-1091, July 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Activated sludge process, *Chlorine, *Ammonia, *Cost analysis, Chlorination, Activated sludge, Process control, Hydrogen ion concentration, Graphical methods, Texas, Houston.

Studies were carried out in two portable treatment units on the site of the proposed Houston 69th Street City 100 MGD Sewage Treatment Plant to determine whether chlorine could be saved by controlling nitrification in an oxygen activated sludge process so that the effluent would produce an ammonia concentration in the 2-4 milligrams/liter range. It was theorized that the ammonia would react with the chlorine to produce a stable combined residual at a much lower chlorine dosage than if the effluent were completely nitrified. Results with the portable units showed that the chlorine requirements could be reduced by 50% or more if nitrification was controlled. Gross savings of chlorine were an estimated $250 thousand annually. There was no apparent effect of pH on chlorine residual in the range of 6.5-7.5 and no change when the nitrification stage was operated with either air or high purity oxygen. (Geiger-FRC)
W83-02427

THE INFLUENCE OF ORGANIC LOADING AND RETENTION PERIOD ON THE PERFORMANCE OF THE ROTATING DISK SYSTEM,
P. S. Cheung, and G. Mack.
Water Pollution Control, Vol 81, No 4, p 553-557, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Nitrification, *Organic loading, *Retention time, Wastewater treatment, Biological oxygen demand, Rotating biological contactors, Hydraulic loading, Biochemical oxygen demand, Federal Republic of Germany, Stuttgart.

A rotating disk system built 17 years ago to treat wastewater from Stuttgart-Busnau was used in plant scale tests. BOD removal and nitrification efficiencies varied with the BOD loading. High BOD removal occurred at low organic loading. Nitrification efficiency was near 100% for BOD loadings up to about 5 g BOD per sq m per day and decreased markedly with increased organic loading. Shorter retention periods decreased BOD removal efficiency. A 3 hour retention period was a reasonable compromise for maximum BOD removal efficiency and minimum tank size. Dilution of the effluent with groundwater (2.4 liters per sec added to 3.0 liters per sec of sewage) improved nitrification efficiency even at shorter retention periods. It was suggested that treated effluent be recirculated to the treatment plant to achieve a higher nitrification efficiency. (Cassar-FRC)
W83-02428

THE ROLE OF PHOSPHORUS IN ACTIVATED SLUDGE,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and M. S. Okrutny.
Water Pollution Control, Vol 81, No 4, p 558-565, 1982. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Phosphorus, *Nutrients, *Limiting nutrients, *Wastewater treatment, Bacteria, Activated sludge process, Chemical oxygen demand, Carbohydrates, Protein, Growth rate, Sludge.

The effect of phosphorus limitation on the activated sludge process was investigated in batch and continuous experiments. Batch studies revealed that the relationship between cell specific growth rate and limiting P concentration was described by a Monod equation. The growth rate of mixed culture varied from 0.092 to 0.64 per hour and the cell yield varied from 25.5 to 117.5 over the COD:P ratio range from 788:1 to 10:1. Maximum specific growth rate was 0.64 per hour, and the saturation constant was 0.378 mg per liter. Specific growth was inversely proportional to cell yield. In the continuous flow culture biological solids production and COD removal were greatly inhibited when the P concentration was less than 5.1 mg per liter or the COD:P ratio was greater than 105:1. Increasing the COD:P ratio increased efficiency of organic substrate removal and ammonia N uptake. Increasing P supplementation significantly reduced cell yield. Sludge carbohydrate as a percentage dry weight increased and sludge protein decreased with decreases in P levels, especially when P was less than 4 mg per liter. Cells in P-limited media had large capsules. (Cassar-FRC)
W83-02429

NEW DEVELOPMENTS IN THE ANAEROBIC TREATMENT OF INDUSTRIAL WASTES,
Water Research Centre, Stevenage (England).
F. E. Mosey.
Water Pollution Control, Vol 81, No 4, p 540-552, 1982. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Sludge digestion, *Anaerobic digestion, *Industrial wastes, Reviews, Wastewater treatment, Digestion, Farm wastes, Animal wastes, Microbiology, Bacteria, Methane bacteria, Fermentation, Process control, Monitoring, Upflow anaerobic sludge blanket, Fluidized beds.

The last 10 years' developments in anaerobic treatment of industrial wastes are reviewed. In microbiology, pure cultures of methane bacteria have been prepared, reaction kinetics have been studied, and the mechanism of fermentation elucidated. Four groups of interdependent bacteria are active: acid forming, acetogenic, acetoclastic methane, and hydrogen-using methane. New gas monitors have aided in process control. Recent designs in equipment include internal heat exchangers removable for cleaning, low-cost farm waste digesters (insulated trench, tanks with polyvinyl chloride gasholder roofs, fixed roof digesters with separate gas holders, and package plants). Industrial waste digesters for dilute wastewaters from the food-processing industry have concentrated on the upflow anaeorobic blanket reactor, anaerobic fluidized beds, and anaerobic expanded bed reactors. In sludge digestion the trends are toward high-rate digesters and package plants. Present problems in sludge digestion are poor process stability at short retention periods, too-slow destruction of fats and greases, inadequate destruction of pathogens, and heating and mixing difficulties. (Cassar-FRC)
W83-02430

A DECADE OF EXPERIENCE AT THE CALDER VALE WPC WORKS,
Yorkshire Water Authority (England).
P. Lowe.
Water Pollution Control, Vol 81, No 4, p 525-539, 1982. 10 Fig, 6 Tab, 7 Ref.

Descriptors: *Activated sludge process, *Sludge digestion, Wastewater treatment, Calder Vale Water Pollution Control Works, *United Kingdom, Sedimentation, Primary wastewater treatment, Screens, Biological filters, Lagoons, Tertiary wastewater treatment, Aeration, Anaerobic digestion, Digestion, Sludge disposal, Land application.

The Calder Vale sewage works in Yorkshire was expanded and updated in three phases starting in 1967. The plant's present operation is described in detail. Flows up to 81,500 cu m per day enter the plant. Excess is discharged to the River Calder. Treatment consists of bar screening, primary sedimentation in tanks, and aerated biological treatment. Sludge is digested, dewatered, and applied to agricultural land. Digester gas is burned to provide heat for the digester process. In 1976 a new inlet works, built within the original brick structure, was commissioned. Major features were three new screw pumps, modification of the curved-bar screens to allow flexing, and spiral-flow detritors. In the primary sedimentation tanks sludge scraping machinery, hoppers, and baffling were installed. Problems were encountered with the scraping machinery and solids loss from the sedimentation tanks. A tertiary lagoon was somewhat helpful in reducing effluent solids concentration. A new filter feed channel and collection channel were among the improvements made to the biological filters. The sludge digester plant, commissioned in 1968, experienced several problems in charging, emptying, valve malfunctions, corrosion in the boiler tubes, explosion of leaked gas, condensation of water in the gas lines, poor transmission of gas to the boiler, sludge buildup on the outside of the Heatamix tubes, and poor settleability of sludge solids. Sludge dewatering and disposal are described. (Cassar-FRC)
W83-02431

COMPLETE TREATMENT OF SEWAGE IN A TWO-STAGE FLUIDIZED-BED SYSTEM. PART 1,
Water Research Centre, Stevenage (England).
P. F. Cooper, and D. H. V. Wheeldon.
Water Pollution Control, Vol 81, No 4, p 447-464, 1982. 8 Fig, 13 Tab, 15 Ref.

Descriptors: *Fluidized beds, *Biological wastewater treatment, *Denitrification, Wastewater treatment, Nitrification, Anaerobic digestion, Aerobic digestion, Digestion, Suspended solids, Performance evaluation, Biomass, Oxidation.

Part of a series on two-stage fluidized bed treatment, this paper reports data obtained in characterizing the anoxic and aerobic reactors. Settled sewage up to concentrations of 200 mg per liter suspended solids was successfully used as a carbon source of denitrification. A high rate of denitrification (5-10 kg nitrate per cu m per day) was achieved. This was 5-10 times higher than in suspended growth systems and corresponded to a retention period of 5-10 min. Two methods for starting up an anoxic fluidized bed proved satisfactory. Passing mixed feed through the system at the flow velocity selected for the experiment was easier than the batch/total recycle method, which used a fresh batch of equal volume of settled sewage and nitrified effluent each day for 4 days. Good BOD removal from the anoxic reactor effluent was attained in the aerobic reactor at high volumetric rates of removal. When the aerobic reactor was produced. This was probably a result of formation of carbon dioxide bubbles and stripping of the biomass. Rapid seeding of the aerobic reactor was done by two methods: (1) the batch feeding/total recycle method and (2) a method using anoxic effluent and nitrate with oxygenation after 11 days growth. An automated sand/biomass separation system produced a sludge containing 6-10% and 4% w/w dissolved solids from the anoxic and aerobic reactors, respectively. The process featured a high speed stirrer and vibrationg sieve. (Cassar-FRC)
W83-02433

MECHANISMS OF BIOLOGICAL PURIFICATION ON ACTIVATED CARBON (MECANISMES DE L'EPURATION BIOLOGIQUE SUR CHARBON ACTIF),
Rennes-1 Univ. (France).
K. Gaid, C. Cavelier, and G. Martin.
Water Research, Vol 16, No 1, p 7-17, January, 1982. 8 Fig, 6 Tab, 5 Ref. English summary.

Descriptors: *Wastewater treatment, *Activated carbon, *Adsorption, *Organic matter, *Porosity, *Bacteria, Organic wastes, Biological wastewater treatment, Correlation analysis, Enzymes, Amino acids, Microorganisms.

The role of adsorbent fixing properties and microorganisms in the treatment of wastewater by activated carbon was examined in a survey of the adsorption properties of activated carbon, studies of the role of fixation sites on the carbon surface, and correlation analyses of the organic pollutants removed with the bacterial mass present on the adsorbing material. Results showed that the microporosity of carbon does not play a significant part in the adsorption of organic matter in sewage, but it does affect the adsorption of certain individual molecules, such as amino acids and enzymes. The presence of fixation sites (metals, surface functions) can have some effect during bacterial development. Research is now in progress to determine the role of specific surface in regard to the adsorbable molecules and its correlation with the bacterial mass. Studies are also underway to assess the part played by the adsorbing material and bacteria in relation to nonadsorbable molecules such as methanol and ethanol. (Geiger-FRC)
W83-02434

5E. Ultimate Disposal Of Wastes

PATHOGEN SURVIVAL DURING FORCED AERATION COMPOSTING OF MUNICIPAL WASTEWATER SLUDGE,
New Hampshire Univ., Durham. Water Resource Research Center.
P. L. Bishop, and W. R. Chesbro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175323, Price codes: A08 in paper copy, A01 in microfiche. Research Report No. 37, December 1982. 157 p, 33 Fig, 30 Tab, 105 Ref. OWRT B-006-NH(3), 14-34-0001-0272.

Descriptors: Compost, *Pathogens, Sludge, Disinfection, *Coliforms, Aspergillus, Nutrients, Nitrogen, Wastewater treatment, *Sludge treatment, *Municipal sludge, *Composting, Bacteria, *Streptococci.

This research investigated the potential for survival of pathogen during and after composting of municipal wastewater sludge by forced aeration, static pile composting method. Both primary and combined primary/secondary sludges were composted. In general, pathogen kill, based on enumeration of fecal indicator organisms and of selected pathogens, was achieved in the deep sections of the compost piles where temperatures reached the thermophilic range. Pathogen kill was not complete in shallower areas of the pile, though, where temperatures did not rise above the mesophilic range. On the order of 100 fecal coliforms and fecal streptococci per gram of compost were still present at the end of the compost period in the shallow samples. Asperfillus fumigatus was detected at all stages of the compost cycle, throughout the piles. Salmonellae and Shigella were never detected in finished compost, due either to competition from native organisms or to severe dessiccation. Fecal coliforms and fecal streptococci in compost added to soil can survive for periods up to two years. Their numbers decrease to non-detectable during cold weather, but they may exhibit regrowth in warmer months. The fecal streptococci detected may be contributed by insects in the soil, rather than by the compost. Although there may be an initial increase in nitrogen in the compost due to nitrogen fixation, overall there is a net loss of nitrogen during the composting process due to mineralization of organic nitrogen, subsequent volatilization of ammonia and denitrification.
W83-02187

EXTRACTABILITY AND SOLUBILITY OF PHOSPHATE IN SOILS AMENDED WITH CHEMICALLY TREATED SEWAGE SLUDGES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
Y. K. Soon, and T. E. Bates.
Soil Science, Vol 134, No 2, p 89-96, August, 1982. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Phosphates, *Sewage disposal, *Land disposal, Anaerobic digestion, Wastewater treatment, Sludges, *Sludge disposal, Solubility, Loam, Sand, Calcium, Iron, Aluminum, *Ontario.

The extractability and solubility of phosphate in soils amended with anaerobically digested sewage that resulted from treatment of sewage with Ca(OH)2, A12(SO4)3, or FeCl3 were characterized. The sludges were applied annually to field plots situated on a loamy sand (pH 7.3) and a loam (pH 7.4) and cropped to corn or bromegrass for 7 years. Extractibility of soil P by NaHCO3 was in the decreasing order of Ca-sludge, Fe-sludge, Al-sludge. Equilibrium P concentration was highest in the loam treated with Ca-sludge and in the loamy sand treated with Fe-sludge. The solubility of P in Ca-sludge-amended soil appeared to be limited by the precipitation of octacalcium phosphate. The Fe-sludge decreased soil pH, and this increased P solubility. Soil Fe and Al oxide content was increased by sludge application. This increased P retention in soil occurred through sorption and occlusion by the oxides. Calcite in the Ca-sludge-amended soil provided additional sorption sites. Fractionation of soil P showed that just over 50% of inorganic P in the Ca-sludge treatment and about 70% in the Al- and Fe-sludge treatments were Al- plus Fe-P. The relatively high Al- plus Fe-P in the Ca-sludge treatment resulted from the use in 1977 of a sludge treated with Ca and Fe. More P was present as loosely bound P and as a Ca-P in the Ca-sludge treatment than Al- and Fe-sludge treatments. (Baker-FRC)
W83-02198

FULL-SCALE THEMOPHILIC DIGESTION AT THE WEST-SOUTHWEST SEWAGE TREATMENT WORKS, CHICAGO, ILLINOIS,
Metropolitan Sanitary District of Greater Chicago, IL.
R. R. Rimkus, J. M. Ryan, and E. J. Cook.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1447-1457, November, 1982. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Digestion, *Sludge digestion, *Anaerobic digestion, *Thermophilic digestion, Meso-

philic digestion, Chicago, *Illinois, Energy, Methane.

In the hopes of increasing digestion capacity, one mesophilic sludge digester at a wastewater treatment facility in the Metropolitan Sanitary District of Greater Chicago was converted to the thermophilic process during a 130 week study. A stable thermophilic digester was established after a year's work. Although a 14-day detention time was achieved early in the study, a 7-day detention time was not reached until weeks 85-92 and again at 120-130. Comparing thermophilic digestion with mesophilic digestion, the volatile fatty acids were 270 and 40 mg per liter, respectively; pH, 7.8 and 7.6; alkalinity, 4500 and 4240 mg per liter; gas production, 0.40 and 0.32 cu m per kg volatile solids fed; volatiles reduction, 34.0 and 31.3%; and ammonia-N, 1200 and 1000 mg per liter. Methane content of digester gas, COD reductions, and fat-oils-grease reductions were similar in both systems. Thermophilic sludge had a slightly more intense odor than mesophilic sludge. The thermophilic digester was not upset by a 3C temperature increase or an increase in volatile solids loading of 2.40 to 4.64 kg per cu m per day at the rate of 10% increase per day. Although energy requirements of the thermophilic process were 120% greater than those of the meso processes, it is believed that this may be offset by the increased gas production and reclamation of waste heat for preheating. (Cassar-FRC)
W83-02280

ANAEROBIC TREATMENT OF THERMAL CONDITIONING LIQUORS,
Gore and Storrie Ltd., Toronto (Ontario). Wastewater Projects Div.
G. V. Crawford, T. Alkema, M. Yue, and M. Thorne.
Journal of the Water Pollution Cntrol Federation, Vol 54, No 11, p 1458-1464, November, 1982. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Digestion, *Anaerobic digestion, *Sludge conditioning, Design criteria, SLudge digestion, *Thermal conditioning liquors, *Wastewater treatment, Lakeview Water Pollution Control Plant, Peel, *Ontario, Biological treatment, Anaerobic packed bed reactor, Secondary wastewater treatment.

Laboratory results on anaerobic packed bed reactor treatment of thermal conditioning liquors are reviewed and used as a basis for designing a full-scale system for the Lakeview Water Pollution Control Plant, Peel, Ontario. Thermal conditioning liquor consists of a mixture of raw sludge and waste activated sludge, which has a COD of 6000-8000 mg per liter and a BOD of 3000-4000 mg per liter. The present method of treating these strong wastes at Lakeview involves recycling the untreated liquor to the plant influent, which adds 1% of the volume but 12% of the BOD, mostly in dissolved form. Preliminary design estimates indicate that BOD and volatile acids could be reduced 80% with organic loadings of up to 16 g COD per liter of initial reactor void volume per day with hydraulic retention times of 1-218 hours. Gas production is expected to be 0.4-0.5 liters per g of COD destroyed; sludge production, 0.1 g per g of COD removed. No supplemental nutrients or pH buffering are likely to be needed. Potential problems in a large scale anaerobic packed bed reactor are bed plugging, unequal feed distribution, improper flow disposal, toxic materials, and shock loadings. For Lakeview's 2.1 cu m per sec of wastewater, a 675 cu m reactor would produce 3500 cu m gas per day and return 945 kg COD per day to the plant influent. Total capital costs are $450,000; annual operating costs, $50,000; and value of gas produced, $60,000 per year. Removal by the present process, recylcing untreated liquor to the influent, costs $230,000 annually. (Cassar-FRC)
W83-02282

OXIDATION OF BIOLOGICAL SLUDGES WITH OZONE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W83-02334

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE I,
Idaho Univ., Moscow.
S. P. Luttrell, and C. E. Brockway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182147, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, January 1983. 52 p, 9 Fig, 29 Ref. OWRT A-084-IDA(1), 14-34-0001-2114.

Descriptors: *Septic tank, *Wastewater disposal, *Nitrates, *Phosphates, Domestic waste, Water quality, Aquifers, Sub-divisions, Nutrients, *Idaho, Big Wood River Vally.

The upper and middle Big Wood River Valley has experienced large population growth associated with recreational development. Much of this growth has been and will continue to be in rural areas, making private and small community water systems and individual on-site sewage disposal facilities necessary. There are currently about 85 approved subdivisions in the study area, with a projected build-out of 2,151 units, 713 of which are currently built. The currently sub-divided buildable area is approximately 5,860 acres of a total buildable area of approximately 21,270 acres. The current building density of non-sewered areas is approximately 6.64 acres per unit for the study area and approximately 1.60 acres per unit for the city of Bellevue. The projected building density of non-sewered areas is approximately 2.21 acres per unit for the study area and approximately 0.75 acres per unit for the city of Bellevue. It is assumed that individual and group on-site sewage disposal facilities currently contribute about 24,900 pounds per year of nitrate (N0 sub 3 -N) and about 4,500 pounds per year of soluble phosphate (P) into the groundwater. The Hailey Woodside treatment-disposal facility currently contributes about 4,100 pounds per year of N0 sub 3 -N and about 740 pounds per year of P to the groundwater. Nutrient loads under maximum projected development are expected to be around 95,000 pounds per year of N0 sub 3 -N and about 17,000 pounds per year of P.
W83-02372

GENERATION AND TREATMENT OF LEACHATE FROM DOMESTIC WASTES IN LANDFILLS,
Water Research Centre, Stevenage (England).
H. D. Robinson, C. Barber, and P. J. Maris.
Water Pollution Control, Vol 81, No 4, p 465-478, 1982, 15 Fig, 6 Tab, 21 Ref.

Descriptors: *Leachates, *Landfills, *Domestic wastes, Municipal wastes, Waste treatment, Wastewater treatment, Chemical oxygen demand, Ammonia, Chlorides, Volatile acids, Fatty acids, Aerobic digestion, Biological treatment.

Landfill leachates were recirculated through the landfills by spraying to produce leachate similar in composition to well-aged, stabilized wastes. BOD, ammonia, and chloride levels and total volume were considerably reduced by the 12-18 month treatment. However, the remaining excess leachate was too high in COD to release untreated to surface waters. A thin permeable cover was suitable for a landfill containing crude domestic wastes, and no cover was best for pulverized refuse. Aerobic biological treatment of fresh landfill leachates in the laboratory showed reduction of COD at temperatures as low as 5-10C. It was necessary to closely control the operating conditions and to add nutrient P. The retention time for substantial COD removal at 10C was 10 days or more. Treatment at 5C was less efficient but still feasible. (Cassar-FRC)
W83-02423

LOW-COST PROVISION OF ANAEROBIC DIGESTION: II. HIGH-RATE AND PREFABRICATED SYSTEMS,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5D.
W83-02424

A DECADE OF EXPERIENCE AT THE CALDER VALE WPC WORKS,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5D.
W83-02431

PILOT PLANT STUDY ON SEWAGE SLUDGE PYROLYSIS--II,
NGK Insulators Ltd., Nagoya (Japan).
T. Kasakura, and M. Hiraoka.
Water Research, Vol 16, No 12, p 1569-1575, December, 1982. 6 Fig, 3 Tab.

Descriptors: *Sludge cake, *Sludge drying, *Incineration, Drying, *Pyrolysis, Pilot plants, Sewage sludge.

Three processes (drying-pyrolysis, direct pyrolysis, and incineration) for pyrolysis of sewage sludge were compared in pilot plant studies. The most cost effective and environmentally acceptable process was drying-pyrolysis, followed closely by direct pyrolysis. Pyrolysis prevented the oxidation of Cr(3+) to Cr(6+), but incineration produced Cr(6+). Heavy metals (especially Hg, Cd, Pb, and As) were released to the gas phase in all three processes. The dryer exhaust gas scrubber wastewater was high in BOD, ammonium ion, and phenolic compounds. The boiler exhaust gas scrubber wastewater was high in suspended solids, sulfate, chloride, and heavy metals. (Cassar-FRC)
W83-02435

5F. Water Treatment and Quality Alteration

REACTIONS OF CHLORINE DIOXIDE WITH HYDROCARBONS: EFFECTS OF ACTIVATED CARBON,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. S. C. Chen, R. A. Larson, and V. L. Snoeyink.
Environmental Science and Technology, Vol 16, No 5, p 268-273, 1982. 3 Fig, 2 Tab, 41 Ref.

Descriptors: *Water treatment, *Chlorination, *Disinfection, Activated carbon, *Hydrocarbons, Chlorinated hydrocarbons, Chemical reactions, Oxidations, Wastewater treatment, *Chlorine dioxide.

Chlorine dioxide (ClO_2) is being investigated as a possible alternative to chlorine for use as a disinfectant in water and wastewater treatment. This study was designed to determine the products resulting from reactions between aqueous chlorine dioxide and some selected hydrocarbons either contained in aqueous solution or adsorbed on an activated carbon surface. Chlorine dioxide was found to react rapidly with hydrocarbons having benzylic hydrogen atoms in dilute aqueous solution. These hydrocarbons, including ethylbenzene, indan, Tetralin, diphenylmethane, and fluorene, reacted, probably via free radical pathways, to produce oxidized derivatives such as ketones and alcohols. Additional halogenated compounds were formed from the chlorine dioxide-hydrocarbon reaction in the presence of activated carbon, but it has not yet been determined whether the granulated activated carbon acts as a true catalyst for these reactions or whether the surface becomes chemically altered. When a hydrocarbon was allowed to react with chlorine dioxide in aqueous solution for 2.9 minutes at pH 3.5 and the reaction mixture was passed over a bed of HD3000 granular activated carbon, monochloro and/or dichloro derivatives were produced in addition to the oxygenated compounds observed in the absence of the carbon. Analysis of the activated carbon columns following application of dilute chlorine dioxide to the columns showed no production of volatile organic compounds, no TOX increase in solution conversion of about 30 percent of the chlorine dioxide to chlorate, and no additional production of halogenated compounds resulting from contact with the carbon. (Carroll-FRC)
W83-02103

UTILIZATION OF MOLECULAR OXYGEN AND SUNLIGHT IN THE OXIDATIVE PURIFICATION OF WATER,
West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5D.
W83-02134

CHARACTERIZATION OF ORGANIC CONTAMINANTS IN SELECTED POTABLE WATER SUPPLIES IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Chemistry.
M. Rodriquez-Flores.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178038, Price codes: A04 in paper copy, A01 in microfiche.
Puerto Rico Water Resources Research Institute Completion Report, Mayaguez, 1983. 54 p, 22 Fig, 2 Tab, 14 Ref. OWRT A-057-PR(1), 14-34-0001-1141.

Descriptors: Wastes, Water supply, *Potable water, *Organic compounds, Analytical techniques, *Puerto Rico, Water treatment, *Pollutant identification, Disinfection, *Chlorine compounds.

The principal objective of this study was to investigate the extent of pollution by organic compounds of the three largest municipal water supplies in Puerto Rico. It was found that there are a number of halogenated organic pollutants present in the municipal water utilities of the cities of San Juan, Ponce and Mayaguez, all of which have been included in the priority pollutant list of the Environmental Protection Agency. There are: chloroform, carbon tetrachloride, chlorodibromomethane, dichlorobromomethane, bromoform, and tetrachloroethylene. The concentrations of these pollutants range in the low parts-per-trillion range, which is the same order of magnitude Juan tap water, tetrachloroethylene, is not known to have a natural origin; therefore, its source is very likely the undue disposition of waste solvents and degreasers. The other compounds are known to be generated when chlorine reacts with the traces of humic material that remains in the water after sedimentation and filtration steps. To test this hypothesis a few tests were made on water from lake Carraizo and from the Rio Anasco, which individually supply most of the raw water to two of the municipal water utilities studied. The concentration of trihalomethanes in all raw waters was undetectable, lending credence to the aforementioned hypothesis.
W83-02218

GAS CHROMATOGRAPHIC ANALYSIS OF HALOCARBONS IN DRINKING WATER BY HEADSPACE EXTRACTION AND MIXED COLUMN SEPARATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
For primary bibliographic entry see Field 5A.
W83-02284

RURAL DRINKING WATER TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
E. M. Roe, and W. E. Sharpe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181776, Price codes: A05 in paper copy, A01 in microfiche.
Partial Completion Report September 1982. 79 p, 26 Ref, 5 Append. OWRT C-00192-T(No 0496)(3), 14-34-0001-0496.

Descriptors: *Technology transfer assessment, *Water quality, *Rural areas, Water treatment, Water supply, Wells, Pumps, Springs, Water, Water treatment equipment, Technology transfer programs, Evaluation, *Rural drinking water, *Technology transfer needs, *Drinking water quality, Small water systems, Information needs, Private water systems.

The assessment of rural drinking water technology transfer needs begins with a short discussion of drinking water problems, in general, followed by the search strategy. In order to identify technology transfer programs and publications, drinking water experts in agencies, associations and citizens groups were contacted, computerized literature searches conducted, and library materials consulted. Primary and secondary users of rural drinking water information are characterized and their needs discussed. Drinking water research and technology transfer programs and products relevant to small water systems owners/operators and individual well owners are discussed and evaluated. Names and addresses of contacts, lists of relevant associations, journal, conferences and technology transfer materials are given in the appendices. It was found that the information needs of small public and individual private water system owners are not being adequately met. Recommendations to improve transfer of technology to these clientele are given. These recommendations include: production of a public health awareness package; production of a water systems information handbook and water treatment fact sheets for primary users; sponsorship of water treatment conferences for secondary users, and finally, the updating of an existing water systems reference book especially useful to secondary users.
W83-02318

DEFLUORIDATION OF GROUNDWATER SUPLIES BY UPFLOW ACTIVATED ALUMINA ADSORPTION PROCESS,
North Dakota Univ., Grand Forks. Engineering Experiment Station.
Y. T. Hung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182089, Price codes: A15 in paper copy, A01 in microfiche.
Completion Report No 81-12-EES-01, December 1981. 316 p, 119 Fig, 13 Tab, 9 Ref, 1 Append. OWRT A-006-NDAK(1), 14-34-0001-0136.

Descriptors: Water supply, Groundwater, *Adsorption, *Water purification, *Coagulation, Separation techniques, *Water treatment, Chemicals, *Activated alumina adsorption process, *Defluoridation, *North Dakota.

An investigation was performed to determine the feasibility of removing fluoride ions from simulated and naturally occurring groundwater samples from representative locations in North Dakota, using batch chemical coagulation-precipitation and adsorption processes, and continuous adsorption processes. The batch chemical coagulation-precipitation and adsorption study involved the use of several agents. Of the eleven additives examined only aluminum sulfate and calcium hydroxide phosphate removed appreciable amounts of fluoride. At dosages of 3000 mg/1, aluminum sulfate and calcium hydroxide phosphate reduced initial fluroide concentrations by up to 97 and 48%, respectively. In the continuous flow adsorption study, the performance of columns packed with activated alumina was based on their ability to adsorb and remove fluoride ions from water samples pumped through each column. Results indicated that adjusting the initial pH to 5, increasing the amount of activated alumina, decreasing the activated alumina particle size, and reducing the flow rate had the greatest effect in improving effluent quality in terms of fluoride concentrations. Increasing alkalinity and TDS reduced the capacity of the alumina columns for adsorption. The operating cost for deflouridation of 10,000 gallons of raw groundwater was approximately $0.04 for a plant design flow of 1.5 MGD (million gallons per day).
W83-02366

SOLIDS CONTAMINATION RESULTING FROM DRAINAGE WORKS IN AN UPLAND CATCHMENT, AND ITS REMOVAL BY FLOTATION,
Yorkshire Water Authority (England).
R. Austin, and D. Brown.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 281-288, 1982. 2 Fig, 6 Tab, 1 Ref.

Descriptors: *Soil erosion, *Flotation, *Turbidity, *Water treatment, Erosion, Holmestyes Reservoir, Afforestation, Water pollution sources, Water distribution, Sediment concentration, Soil management, Agricultural runoff, England.

Deep plowing for afforestation in the Holmestyes catchment, United Kingdom, exposed the underlying clay stata to servere erosion during heavy rainfall in October 1980. Turbidity of the raw water reached 1000 FTU, totally unsuitable for treatment. As a short-term remedial measure additional chlorine was dosed for the 11 hours between discovery of the pollution and plant shutdown. Cross-connections with alternative supplies were made. The extra load on the other treatment plants caused deteriorated water quality and numerous main bursts. Dosing the reservoir with lime and alum did not significantly improve the raw water in the short-term, requiring backup water from a compensation reservoir, to which overland plastic pipe was laid. As a long-term solution a package dissolved air flotation plant was installed. It became operational 11 months after the initial pollution problem. (Cassar-FRC)
W83-02377

CREATING THE DENVER WATER DEPARTMENT'S SECURITY PROGRAM,
Denver Board of Water Commissioners, CO.
R. G. Jenson.
Journal of the American Water Works Association, Vol 74, No 10, p 509-511, October, 1982.

Descriptors: *Risks, *Security, *Utilities, *Water treatment, Denver, *Colorado, Safety, Water pollution prevention, Drinking water, Water treatment facilities.

The Denver, Colorado, Water Department recognized the need for a security program in 1975. Although the department had not suffered security losses over its 60-year history, many possibilities for security problems existed, including 20 dams and reservoirs, 950 employees, 400 vehicles, 2 sophisticated computer systems, processing of $80 million in funds each year, 3 treatment plants, and inventories greater than $30 million. For the first 3 years of the program the plant division dealt with security problems that were specifically identified, such as perimeter fences, remote alarm systems, a modern lock and key system, employee pilferage, inventory control procedures, and a security guard system. To better meet the overall security needs the department hired a risk management consultant in 1978. Security was identified as a part of an overall risk management program. This program has not only saved money for the water department, but employee awareness of security problems has been heightened. In 1979 significant misappropriation of property was uncovered. Since then several steps have been taken to increase security. These include gates at the central administration building, equipping caretakers at remote facilities with firearms and guard dogs, remote entry systems for remote stations, an alarm system for the cashier operation, and termination of 12 department employees for drug-related offenses. (Cassar-FRC)
W83-02384

THE INTEGRATION OF SMALL-SCALE IRRIGATION AND VILLAGE POTABLE WATER SYSTEMS IN GUATEMALA,
Inter-American Foundation, Rosslyn, VA.
S. Annie, and S. B. Cox.
Water Supply and Management, Vol 6, No 5, p 455-464, 1982. 13 Ref.

Descriptors: Water resources development, *Irrigation programs, *Potable water, Rural areas, *Developing countries, *Guatemala, Water supply, Drinking water, Public health, Diseases, Benefits, Social aspects, Economic aspects, Springs, Gravity springs.

This paper proposes the integration of small-scale irrigation and potable water systems for rural villages in the Guatemalan highlands, which is richly endowed with springs. Currently potable water is brought from a supposedly clean spring by gravity feed to a distribution tank in the village. Feeder lines deliver water to individual homes or public taps. Estimates of the population currently having access to potable water vary from 15 to 45%. The small-scale irrigation projects are quite similar in construction to the potable water projects. Large

diameter polyvinyl chloride, steel, or concrete piping is used to bring water from a higher spring for application to the fields by sprinkler systems. Storage tanks are not used because the demand is constant. These two types of projects are often planned independently in the same building. It is recommended that feeder lines be added to the irrigation systems to bring water to homes or public taps. If the source is not a protected spring, treatment facilities or a parallel system using a safe spring must be constructed. Benefits of this integration are economies of scale, greater ease of promoting the project to the community, better possibilities for self-financing, and more efficient use of labor. Several issues must be resolved before starting an tintegrated program: engineering and technical, economic, program design, institutional, and community equity. (Cassar-FRC)
W83-02394

DETERMINING THE CONCENTRATION OF EASILY ASSIMILABLE ORGANIC CARBON IN DRINKING WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
D. Van Der Kooij, A. Visser, and W. A. M. Hijnen.
Journal of the American Water Works Association, Vol 74, No 10, p 540-545, October, 1982. 7 Fig, 7 Tab, 38 Ref.

Descriptors: *Organic carbon, *Bacteria, *Pipes, *Pollutant identification, Assimilable organic carbon, Dissolved organic carbon, Polyvinyl chloride, Pseudomonas, *Water treatment, Water distribution, Bioassays, Drinking water, Water distribution, Microbial growth, Ozonation, Water analysis.

A method for determining the potential of a water for supporting microbial regrowth in a drinking water distribution system is described. This bioassay is based on the growth of Pseudomonas fluorescens as a function of the concentration of easily assimilable organic carbon (AOC), which includes humic and fulvic acids, amino acids, peptides, fatty acids, hydroxycarboxylic acids, and carbohydrates. A linear relationship was seen between the concentration of acetate C added to tap water and the maximum growth of P. fluorescens strain P17 from 5 to 50 micrograms acetate C per liter. AOC concentrations in various water samples were: biologically treated wastewater, 3.0-4.3 mg acetate C equivalent per liter; several rivers and lakes, 0.08-0.128 mg acetate C equivalent per liter; river water after bank filtration, 0.7-1.2 micrograms acetate C equivalent per liter; anaerobic groundwater, 6.8-9.0 micrograms acetate C equivalent per liter; and aerobic groundwater, 0-1.2 micrograms acetate C equivalent per liter. The percentage of AOC compared with total dissolved organic carbon ranged from 27% in the treated wastewater to < 1% in the bank filtered river water and groundwaters. AOC concentrations were determined at different stages of the water treatment process at four plants. These levels were increased by ozonation and decreased by dual media filtration, granular activated carbon adsorption, coagulation, and rapid filtration. Slow sand filtration had a minimal effect on AOC concentrations. The percentages of AOC in the total dissolved organic carbon were higher after the ozonation step (up to 6% in one plant) and < 1% after all other steps. Plasticized polyvinyl chloride water pipe released more AOC initially and after several weeks' incubation than polyethylene 25 and 50, silicone, and unplasticized polyvinyl chloride. (Cassar-FRC)
W83-02397

5G. Water Quality Control

A MODEL FOR MANAGING SOURCES OF GROUNDWATER POLLUTION,
Geological Survey, Menlo Park, CA.
S. M. Gorelick.
Water Resources Research, Vol 18, No 4, p 773-781, August, 1982. 7 Fig, 3 Tab, 20 Ref.

Descriptors: *Groundwater management, *Pollution control, *Groundwater pollution, *Model studies, *Water pollution control, Water supply, Water management, Water pollution sources, *Waste disposal.

The waste disposal capacity of a groundwater system can be maximized while maintaining water quality at specified locations by using a groundwater pollutant source management model that is based on linear programming and numerical simulation. The decision variables of the management model are solute waste disposal rates at various facilities distributed over space. A concentration response matrix is used in the management model to describe transient solute transport and is developed using U.S. Geological Survey solute transport simulation model. The management model was applied to a complex hypothetical groundwater system. Large-scale management models were formulated as dual linear programming problems to reduce numerical difficulties and computation time. Linear programming problems were solved using a numerically stable, available code. Optimal solutions to problems with successively longer management time horizons indicated that disposal schedules at some sites are relatively independent of the number of disposal periods. Optimal waste disposal schedules exhibited pulsing rather than constant disposal rates. Sensitivity analysis using parametric linear programming showed that a sharp reduction in total waste disposal potential occurs if disposal rates at any site are increased beyond their optimal values. (Baker-FRC)
W83-02161

CALCULATION OF POLLUTANT REMOVAL DURING GROUNDWATER RESTORATION WITH ADSORPTION AND ION EXCHANGE,
Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau.
Water Resources Research, Vol 18, No 4, p 1117-1125, August, 1982. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Groundwater management, *Water pollution control, Ion exchange, Adsorption, Ammonium, Water quality, Leaching, Mining, Industrial wastes.

A simplified and computationally efficient method is presented for calculation of pollutant removal rates during groundwater restoration processes. The method is based on the condition that the influence of dispersion is frequently negligible and solves the resulting transport problem using the method of characteristics. The hydraulic information required by the method is obtained from conservative tracer breakthrough curve for a flow system. The influence of adsorption and ion exchange chemistry on species transport is included through application of the method of characteristics. The combined result gives the effluent concentration at a production well as a function of time during a restoration project. The method is applicable for any well pattern, and its economy is such that a pencil and paper calculation will suffice for yielding quantitative answers for complex flow problems. The method is applied to calculate ammonium removal rates for site restoration by recirculation with chemical sweeps following in situ leach mining of uranium. (Baker-FRC)
W83-02165

SYSTEMS ANALYSIS APPLIED TO THE PROTECTION AND ENHANCEMENT OF THE WATER QUALITY OF LAKE MACBRIDE,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
W. L. Paulson, and L. D. McMullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177931, Price codes: A07 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute Publication No 79, Iowa State Univ., Ames, January 1983. 115 p, 41 Fig, 28 Tab, 82 Ref. OWRT A-051-IA(1), 14-34-0001-6016.

Descriptors: Lakes, Water quality, Eutrophication, *Iowa, Lake MacBride, *Systems analysis, Model studies, *Optimization, Land runoff, Agricultural watersheds, Eutrophic lakes, Simulation, Soil loss, Nitrogen, Phosphorus, Resource allocation model.

This study reports on the development of an optimization model to determine strategies for controling the impact of land runoff on lake water quality. An Iowa agricultural watershed, and Lake MacBride were analyzed. It was found that the lake was a stratified eutrophic lake. Phosphorus was the limiting nutrient in early summer with nitrogen becoming limiting in the early fall. The nutrient input study indicated that 54% of the phosphorus and 91% of the nitrogen came from land runoff. Thirty six percent of the phosphorus came from the Solon wastewater treatment plant. With 75% compliance of good soil conservation, 77% of the phosphorus would come from Solon. A lake water quality simulation model, a watershed soil loss simulation model and a resource allocation optimization model were developed. The lake model simulated the water quality from May 1 to September 1. The soil loss model well represented soil loss in the basin utilizing 40 acre or less subdivisions. The optimization moden indicated that runoff control of up to 75% will result in enhanced water quality. The optional allocation of resources was $2 million in soil conservation plus nutrient removal at the wastewater treatment plant.
W83-02208

BIOLOGICAL TREATMENT OF ACID MINE DRAINAGE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178111, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Research Report No 173, Univ. of Illinois, Urbana-Champaign, October 1982. 87 p, 22 Fig, 8 Tab, 36 Ref. OWRT A-096-ILL(1), 14-34-0001-9015.

Descriptors: *Mine drainage, *Anaerobic digestion, *Biological treatment processes, *Sulfate reduction, Neutralization, *Wastewater treatment, Hydrogen ion concentration, Aeration, Settling.

Research was conducted to evaluate methods for the biological treatment of acid mine drainage (AMD). Two general approaches were evaluated. The first evaluated treatment of impounded AMD through the addition of a mixed microbial community and carbon sources appropriate for their maintenance. Several methods were attempted to provide suitable microbial communities, carbon sources, and environmental conditions suitable for continuous microbial activity. Wood dust and typical solid waste materials were shown to support sulfate reduction, but maintenance of sulfate reduction in AMD solutions was limited. In addition to wood dust and solid waste materials, sponge substrates were used to 'package' the microbial community in portable units which could be added to AMD impoundments. Sustained sulfate reduction was not obtained and water quality improvement was minimal. Most significant of the mechanisms was the potential for wood dust improvement of AMD quality when no biological activity was present. To provide adequate treatment of AMD, a second approach was directed to evauation of a biologically based unit process for AMD treatment. Using an anerobic digestor which provided waste liquors high in organic acids, AMD was mixed with digestor effluent in an anaerobic reactor which maintained sulfate reduction. The end result was production of an effluent with low iron concentrations and no detectable heavy metals with a pH in the range of 6.5 to 8.5. The utility of a pilot plant design incorporating anaerobic digestion, sulfate reduction, aeration, and final clarification and settling was demonstrated.
W83-02231

VIRAL CONTROL OF NUISANCE BLUE-GREEN ALGAE,
California Univ., Riverside. Dept. of Plant Pathology.
P. R. Desjardins, and G. B. Olson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178129, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, September 1982. 59 p, 13 Fig, 4 Tab, 65

Ref. (California Water Resources Center Project UCAL-WRC-W-533), OWRT A-066-CAL(1).

Descriptors: *Nuisance algae, *Algal control, *Viruses, *Bacteriophage, Algal blooms, Biocontrol, Algicides, *Cyanophyta.

Phage strain studies in the AS cyanophage group demonstrated that a supposedly new cyanophage was a serologically related strain of AS-1. Other studies in the Anabaena cyanophage group determined that the A-4 phage preparation, which was described as a temperate phage, was actually a mixture of a lytic and a temperate phage. In addition, Anabaena variabilis Strain S, originally isolated from soil, was found to be a new host for all three phages (A-1, A-4 and AN-10) used in the study. An antiserum to the LPP-1 cyanophage was prepared utilizing a highly purified preparation of the phage as antigen. The anitiserum, which had a relatively high titer (one lot-1:8192) was prepared for future detection of the cyanophage in water. Storage survival studies of species of both unicellular and filamentous cyanobacteria demonstrated that some species can survive for several months by simply freezing them at -20C in the culture growth medium. The fact that other species could only survive for relatively short periods under identical conditions indicates a need for further study on storage of cyanobacteria. Studies on the effects of freezing on AS-1 and LPP-1 cyanophages provided evidence for actual alteration of virion structure as well as significant decreases in the infectivity titers of the two cyanophages. In long term stability studies on AS-1 cyanophage we have found that the molarity of the buffer and the presence of MG++ions are critical for phage survival. This is of special interest since it was generally believed that this phage was very stable and had no requirement for mg++ ions.
W83-02232

METHOD OF CALCULATING A COMPLEX OF WATER CONSERVATION MEASURES IN THE CASE OF INTERBASIN WATER TRANSFER,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
L. Ya. Anishchenko, F. V. Stol'berg, and G. A. Sukhorukov.
Water Resources, Vol 9, No 1, p 53-60, 1982. 1 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No 1, p 94-101, January-February, 1982.

Descriptors: *Water transfer, Water management, *Water conservation, *Interbasin transfers, *Water quality control, Model studies, Economic aspects, Self-purification, Wastewater disposal, Rivers, Intakes, Planning, Canals, *USSR, Oka-Don-Oskol system.

A method was developed for calculating a complex of water conservation measures for regional interbasin transfer systems, accounting for processes of self-purification in rivers and allowing optimization of expenditures on water conservation when water users' requirements are fulfilled. Application to the Oka-Don-Oskol system illustrated the procedure. In this case the system was divided into 5 stretches. It was possible to develop a plan for the optimum start-up and sequence of proposed projects to simultaneously achieve the most economic water conservation measures and water quality objectives. The most economical location for an intake on the source river was also determined. (Cassar-FRC)
W83-02240

ACIDITY CONTROL IN THE NORTH BRANCH POTOMAC,
Interstate Commission on the Potomac River Basin, Rockville, MD.
D. P. Sheer, and D. C. Harris.
Journal of the Water Pollution Control Federation, Vol 54, No 11, p 1441-1446, November, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Reservoir releases, *Neutralization, *Acid mine drainage, Effluents, Buffers, Water quality control, Alkalinity, Acidity, Water management, Wastewater treatment, Mine drainage, Savage River, *Potomac River, Bloomington Dam, Westernport, Maryland, West Virginia.

The impact of acid mine drainage on a 40 km rach of the North Branch of the Potomac River will be lessened by construction of the Bloomington Dam and by discharge of highly buffered, alkaline effluent from the Westvaco Corporation's pulp and paper mill through the Westernport municipal treatment plant. The treatment plant exerts a neutralizing effect of 13.6 metric tons of CaC03 per day. A reservoir operating policy was developed to average the acid releases within minimum flow, water supply, and flood control requirements. This can be attained by making maximum use of the alkaline treatment plant effluent, maintaining the highest possible pH at the reservoir bottom, and maintaining sufficient water capacity to dilute occasional highly acidic inflows. An equation for determining the neutralization requirement (moles of bicarbonate needed to raise a particular volume of reservoir water to a target pH) depends on the flow, alkalinity, and the time of reservoir releases for both the Potomac and the Savage River. (Cassar-FRC)
W83-02259

THE DISTRICT OF COLUMBIA WATER RESOURCES RELATED ACTIVITIES 1980-1981,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180307, Price codes: A04 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center Report No 38, December 1981. 41 p, 8 Fig, 11 Tab, 2 Append. OWRT A-999-DC(3), 14-34-0001-0109.

Descriptors: *Federal government, *District of Columbia, *Inter-agency cooperation, *Local government, *Regional planning, *Water supply, Drought simulation, *Sludge disposal, Resources allocation, Urbanization, Short term planning, Long term planning, Interstate commission, Urban runoff, *Water pollution control.

This report is a summary of events which have taken place in water resources in Washington, D.C. During the years 1980 and 1981 much has been done in water and water related activities. This report addresses the critical water management issues in the District of Columbia, namely, the sludge disposal management, and the regional metropolitan Washington cooperation for water supply. Important studies and projects concerning the District of Columbia five year strategy for wqter pollution control, non-point source pollution, cooperative water supply operations on the Potomac, and the Blue Plains Feasibility Studies are described. Brief summaries of other major studies on the upper Potomac estuary and the related water quality models were given. For each activity, the status and the major agencies involved were provided. The Part II of the report is a statistical update of the meteorological, water quality, water supply, wastewater flows, organic loading, and population characteristics data.
W83-02293

LAKE MERRITT RESTORATION PROJECT, FINAL REPORT,
R. W. Hofmann, and G. W. Shawley.
California State Water Resources Control Board, Publication No 82-5TS, Sacramento, January 1982. 129 p, 32 Fig, 21 Tab, 21 Ref, 8 Append.

Descriptors: *Lake restoration, *Rehabilitation, *Algal growth, *Nuisance algae, *Aquatic weeds, *Dredging, Riprap, Nutrient removal, Sediment control, Aeration, Oxygenation, Water level, Water depth, Aquatic weed control, Cost-benefit analysis.

Lake Merritt, in Oakland, Calif., is used for flood control, fisheries and wildlife habitat, recreation and aesthetic appreciation; however, it has water quality problems such as nuisance growths of algae and widgeon grass. The objective of this project is to develop rehabilitation stragegies which would lead to complete or near-complete restoration and enhancement of the lake. Single rehabilitation actions will not restore the lake to the standards desired; some single methods excluded were nutrient removal/inactivation, sediment traps, controlling input sources, bottom dragging and aeration. The remaining single rehabilitation methods--harvesting, water level control, herbicides, riprapping, minor and major dredging--have been combined into seven strategies which will provide varying levels of restoration to and enhancement of the lake. The Reactive approach would only react to growths by harvesting, and the Modified Reactive approach would harvest growths but not solve the causes of growths; therefore, these methods were excluded. An aquatic weed inhibition strategy would require ongoing use of herbicides and use of an oxygenation system, so is not a favored approach. Intermediate rehabilitation and full rehabilitation without dredging Area VIII also have drawbacks. Full rehabilitation is the favored and most permanent solution. It includes major dredging and riprapping the shoreline shelf. Harvesting would only be needed occasionally and minimal managment would be required. Funding requirements might favor staged full rehabilitation over nine years, which would have the same end results but with slower immediate solutions. (Atkins-Omniplan)
W83-02298

THE KELP FORESTS OF PALOS VERDES PENINSULA 1982,
California State Dept. of Fish and Game, Sacramento.
For primary bibliographic entry see Field 5C.
W83-02304

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, FEBRUARY-DECEMBER 1979, PHASE II.
Water and Air Research, Inc., Gainesville, FL.
Army Corps of Engineers, Mobile District Technical Report ACF 80-11, December 1982. 653 p 4 Fig, 20 Tab, 86 Ref, 15 Append. DACW01-78-C-0101.

Descriptors: *Water quality, *Reservoirs, *Turbidity, *Aquatic plants, *Aquatic animals, *Bacteria, *Lake Seminole, Sediments, Nutrients, Productivity, Algae, Zooplankton, Invertebrates, Alkalinity, Specific conductance, Dissolved solids, Hydrology, *Florida, *Georgia, Alabama.

Meteorological, hydrological, water quality, sediment, and biological data were obtained at a total of 19 main sampling stations in Lake Seminole, the Chattahoochee River, the Flint River, Spring Creek, Fish Pond Drain, and the Apalachicola River during Phase II. Average monthly flows through the impoundment during Phase II ranged from 349 cu m/s during August to 1518 cu m/s during April. As a result of operational procedures at the Walter F. George Lock and Dam, flows through Chattahoochee River impoundment arm exhibited considerable short term variation. Each of the major impoundment arms of Lake Seminole tended to be well-mixed both laterally and vertically. Average turbidity levels in the Chattahoochee River were approximately two to three times those in the Flint River. Specific conductance, total dissolved solids, and alkalinity were lowest at the Chattahoochee River sites and generally higher on the Flint River. Based on nutrient content, the waters of Lake Seminole tended to be moderate to highly productive with respect to the production of algal biomass. At stations 16 and 17 on the Flint river, phytoplankton and zooplankton densities were unusually low. The bacteriological quality in Lake Seminole ranged from good in the upper Chattahoochee River stations and at the lake stations to poor at station 17 in the Flint River. Bottom sediments ranged from relatively clean sands in the rivers to sand and sandy loams in the impoundment itself. Benthic macroinvertebrate populations tended to be closely associated with the nature of the substrate. Emergent and floating aquatic macrophytes covered over 40% of the total reservoir surface area. (Moore-SRC)
W83-02312

URBAN PLANNING CRITERIA FOR NON-POINT SOURCE WATER POLLUTION CONTROL,
Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
G. K. Young, and D. L. Danner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182261, Price codes: A09 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 35, Univ. of the District of Columbia, March 1982. 163 p, 21 Fig, 14 Tab, 45 Ref, 2 Append. OWRT A-009-DC(1), 14-34-001-1109.

Descriptors: *Water pollution, *Urban hydrology, *Water quality modeling, Planning criteria, In-line storage, Stormwater detention, Sewer separation, Street sweeping, Sewer flushing, Wastewater treatment, Best management practices, *Nonpoint pollution sources.

The research described in this document couples urban storm runoff quality and control alternatives within the context of an urban sewerage system to evaluate various combinations of alternatives through their pollution removal efficiencies and their costs. A model has been developed which simulates the response of a typical urban area to a time series of rainfall events, and which uses the District of Columbia as an example. The modeling of the flow of runoff and sewage has been performed at a macro level; the control alternatives examined include in-line storage, sewer separation, street sweeping, sewer flushing, stormwater detention, and increased treatment capacity. Each pollution abatement measure is described with a pollution function, a pollution removal function, and a cost function. The simulation model with its associated decision criterion was validated against actual water quality data for Washington, D.C. The model demonstrates that a macro approach to cost/benefit analysis of non-point source water pollution can evaluate control tradeoffs in terms of cost or in terms of abatement effectiveness. The importance of the developed methodology is that it provides an accurate estimate of urban pollution loads, pollution control capabilities, and control costs without requiring complex graphical techniques or large, explicit simulations. The user is not required to supply any technical or specialized information to run the model; the only inputs to the model are readily available physical characteristics of the urban area.
W83-02317

MICROBIOLOGICAL CONTROL OF THE AQUATIC WEED, MYRIOPHYLLUM SPP,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 4A.
W83-02321

ALBEMARLE SOUND - TRENDS AND MANANAGEMENT NEEDS.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181990, Price codes: A05 in paper copy, A01 in microfiche. Proceedings, Conference at the College of the Albemarle, Elizabeth City, NC, March 3, 1982. Univ. of North Carolina Water Resources Institute, Publication UNC-WRRI-82-178, Raleigh, April 1982. 92 p, (11 Papers), 1 Append. OWRT A-999-NC(56).

Descriptors: *Water quality, *Coastal waters, Coastal streams, Algae, Nutrients, Fish diseases, Fisheries, Saline-freshwater interfaces, *Albemarle sound, Eutrophication, *Algal blooms, Cyanophyta, *Brackish water, Water pollution effects, Chowan River, *North Carolina.

A conference was held March 3, 1982, to focus on the water quality in the rivers and sounds of the Albemarle region with special emphasis on the Albemarle Sound. The Sound and its associated tributary estuaries represent a vast complex of fresh to brackish-water creeks, rivers, and open-water sounds constitute a significant portion of the North Carolina coastal system. Major presentations in the Conference included: a historical perspective of the Albemarle Sound, its economic and social importance, its ecology and physical characteristics, an overview of the current water quality study plan, environmental factors causing blue-green algal blooms in the Chowan River fisheries production in the Sound, and agricultural resources and trends of the region. A North Carolina legislative study commission reviewing the problems and needs of the Chowan River and Albemarle Sound is expected to make recommendations to the 1983 General Assembly for long-term studies and action plans to improve water quality and fisheries in these waters.
W83-02325

EFFECT OF HYDRILLA-GROWTH INHIBITING EXTRACTS UPON THE GROWTH OF SCENEDESMUS OBLIQUUS,
University of South Florida, Tampa. Dept. of Biology.
P. M. Dooris, W. S. Silver, and D. M. Martin.
Journal of Environmental Science and Health, Part A, Vol 17, No 5, p 639-645, 1982. 3 Fig, 9 Ref.

Descriptors: *Weed control, *Algae, *Hydrilla, *Aquatic weed control, Growth, Plant growth, Inhibition, Scenedesmus obliquus, Lake Starvation, *Florida, Lake sediments, Submerged plants, Herbicides.

A hydrilla growth inhibitor extracted from the sediments of Lake Starvation, Florida, did not inhibit growth of fresh water alga Scenedesmus obliquus at concentrations inhibitory to hydrilla, 0.4 ppm organic carbon. Algae cultures were stimulated at levels of 6-12 ppm organic carbon and were inhibited at 18 ppm organic carbon and 0.01 ppm Fe. Sediments in Lake Starvation are derived principally from degradation of bald cypress organic matter. The dark-colored active fraction loses its activity upon anion exchange resin treatment but upon cation exchange resin treatment. Infrared spectra indicate a complex polyphenolic composition. (Cassar-FRC)
W83-02358

GROUNDWATER POLLUTION: A CASE STUDY,
Waterloo Regional Municipality (Ontario). Marshland Centre.
J. D. Pawley.
Journal of the American Water Works Association, Vol 74, No 8, p 405-407, August, 1982. 2 Fig.

Descriptors: *Groundwater pollution, *Case studies, *Oil recovery, *Oil pollution, *Oily water, Industrial wastes, Water pollution, Aquifers, Streams, Phenol, Chloride, Sulfates, Monitoring, Drinking water, Waterloo, *Ontario, Canada.

A case study is presented of groundwater pollution caused by acid sludge discarded by an oil recovery plant into a series of lagoons near Waterloo, Ontario, Canada. The lagoons were later filled with native material, and now the waste is leaching laterally into a pond and stream as well as downward to the aquifer. Induced infiltration drinking water wells terminate in this aquifer. Actions taken to date include monthly sampling of phenol, chloride, and sulfate levels, a steel liner to separate the stream from the lower aquifer, and diversion of upstream water around the leachate pond. An in-depth study of the contamination problem has also been undertaken. A long-term, cost-effective solution has not yet been found. (Small-FRC)
W83-02378

ALTERNATIVES FOR CONTROLLING ORGANICS IN GROUNDWATER SUPPLIES,
Pirnie (Malcolm), Inc., Paramus, NJ.
J. E. Dyksen, and A. F. Hess, III.
Journal of the American Water Works Association, Vol 74, No 8, p 394-403, August, 1982. 9 Fig, 4 Tab, 15 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Land disposal, Water pollution effects, Aeration, Adsorption, Activated carbon, Resins, Water treatment, Water pollution.

Source control and water treatment techniques for controlling organics in groundwater supplies are discussed. In each of 24 states, at least one community has detected one or more synthetic organic compounds in its groundwater supply. A major source of organics is land disposal of domestic and industrial wastewater and solid wastes. Management techniques for control of organics include elimination of the source, location of a new water source, and blending of existing water sources. Treatment techniques include aeration, adsorption and combined control strategies. Management techniques have the lowest cost. Three adsorption techniques: granular activated carbon, powdered activated carbon, and synthetic resins, have received much attention in the United States for the treatment of large surface water supplies. (Small-FRC)
W83-02385

PLANNING FRAMEWORK AND MODELLING OF WATER QUALITY FROM RAINFED AGRICULTURAL LANDS,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 5, p 359-374, 1982. 6 Fig, 9 Ref.

Descriptors: *Water quality control, *Agricultural watersheds, *Nonpoint pollution sources, Planning, Model studies, Fate of pollutants, Water pollution sources, Watershed management, Sediments, Nutrients, Pesticides, Management, Monitoring.

A framework for planning a water quality control program for receiving waters in agricultural watersheds is described. It consists of three phases: (1) identification of agricultural nonpoint source water quality problems, (2) development of best management practices (BMP), and (3) implementation of BMP. Problems may be identified by monitoring the receiving water and determining the impact of any pollutant. Pollution sources and their magnitude are determined. The significance of agricultural pollutants with respect to overall pollution from natural sources, point sources, and other nonpoint sources is determined. BMP's are developed by investigating available methods and determining their applicability to the watershed in question. This may involve collection of field data and determination of cost effectiveness. Several models are available to assess the fate of sediments, salts, nutrients, and pesticides, notably the Universal Soil Loss Equation, the Agricultural Runoff Management (ARM) model, Cornell models for Nutrient Simulation (CNS) and pesticides (CPM), and simulation of soil moisture and chemistry. The success of a chosen watershed management method depends on farmers' acceptance. Implementation of BMP's is not discussed in detail. (Cassar-FRC)
W83-02392

FACILITATION OF COMMUNITY ORGANIZATION,
Research Triangle Inst., Research Triangle Park, NC.
For primary bibliographic entry see Field 6B.
W83-02395

NUCLEAR POWER REACTOR ACCIDENTS AND THE ROLE OF WATER SYSTEM MANAGERS,
S. Davies, and J. C. Bumstead.
Journal of the American Water Works Association, Vol 74, No 8, p 382-390, August, 1982. 8 Fig, 7 Tab, 17 Ref.

Descriptors: *Radioactivity, *Radioactivity effects, *Nuclear powerplants, *Nuclear reactors, *Hazards, *Management planning, Planning, Accidents, Water pollution, Water supply, Iodine, Strontium, Cesium.

As a guide to water system managers preparing for the remote possibility of nuclear reactor accidents, technical formation is presented on the release of radioactivity. Operable and compatible emergency response plans should be developed if a release would be likely to contaminate a public water source. Water sources located within the 16.1 km Emergency Planning Zones must be maintained

and operated during radiation accidents. Federal, state, and local agencies will work closely with managers in the evaluation of contamination and the planning of protective actions to protect the public. Potential doses of radioactive materials including iodine, strontium, and cesium, are quantified. Remedial actions which could be taken by water system managers include sheltering and evacuation of people and development of emergency measures to restrict ingestion of contaminated waters. (Small-FRC)
W83-02398

ECONOMIC POTENTIALS FOR MANAGING NUTRIENT LOSS WITH ALTERNATIVE IRRIGATION TECHNOLOGIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 6F.
W83-02403

MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION,
H. R. Evans.
Water Pollution Control, Vol 81, No 4, p 566-569, 1982.

Descriptors: *Water pollution control, *Sludge disposal, *Wastewater treatment, Land application, Cadmium, Monitoring, Odor control, Coastal water, Plastics, Nonpoint pollution sources, *United Kingdom.

The Institute of Water Pollution Control submitted a number of views to the Royal Commission on Environmental Pollution. Sludge utilization policies support development of guidelines for sludge disposal on land, the elimination of Cd plating or pretreatment of Cd wastes, and sludge analyses for toxic materials and pathogens. Sewage treatment authorities should have the power to constrain housing development on the boundaries of the plant to prevent odor complaints, since odor control measures in the plant are very expensive. The chemical composition of proprietary materials discharged into sewers should be readily available to pollution control authorities. Caution is urged on immediate implementation of the legislation controlling pollution in coastal waters in the absence of specific pollution problems. The Institute recommends that sewage plant discharges should be monitored by a neutral party, not by the plant generating the effluent. Problems of nonbiodegradable plastics in sewage are stressed. Concerns about nonpoint source pollution include agricultural chemicals, fish farms, leachates, acid rainfall, and afforestation. (Cassar-FRC)
W83-02425

RIVER BASIN MANAGEMENT IN AN INDUSTRIAL AREA,
Yorkshire Water Authority (England).
H. B. Tench.
Water Pollution Control, Vol 81, No 4, p 511-524, 1982. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Water pollution control, Industrial wastes, Mine drainage, Yorkshire Water Authority, Don River, River basins, Water management, Management, Costs, Economic aspects, Model studies, Effluents, *England.

Changes in management of the River Don basin, England, since the formation of water authorities in 1974 are described. Major pollution problems in this industrial area are coal carbonizing plant effluents, paper mill discharges, coal mine drainage, municipal effluents, and combined sewer overflows. The reorganized management is based on 3 river basin areas, Don, Dearne, and Rother, rather than the 4 large towns. Cost saving measures have held the rise in costs to 4% from 1977 to 1980 in spite of 2 new plants. There has been no improvement in effluents from works serving under 1000 population. Effluent BOD averaged 57 mg per liter for works serving under 200 people and 30 mg per liter for works serving 200-1000 people. Larger works produced effluent BOD of 16-18 mg per liter. There are essentially no fish in the Don and its associated streams except in the headwaters. The Rother is one of the country's most polluted rivers. Models for determining acceptable pollutant loads in wet and dry weather are described. Improvement in river quality are hampered by lack of capital funds and lack of legislation to control mine drainage. (Cassar-FRC)
W83-02432

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

INTERACTIVE MODELING AND DATA MANAGEMENT FOR PREDICTING SURFACE AND GROUNDWATER QUALITY AND QUANTITY,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
D. P. Loucks, and J. R. Stedinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173211, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, January 1983. 24 p, 5 Fig, 27 Ref. OWRT A-092-NY(1), 14-31-0001-1134.

Descriptors: *Surface-groundwater relations, *Computer models, *Simulation analyses, *Water management, Water quality, *Interactive computer graphics, Systems analysis, Hydrologic systems, *Graphic display, Groundwater contamination, Decision making.

This report outlines an approach to the study of coupled surface and groundwater systems. It reports on the progress of one-year exploratory research project on the development of methods for linking various models and data together, interactively, to enable the prediction and study of regional water quantity and quality problems. Interactive computer graphics are used to facilitate spatial data input, editing and display, and for model management and sequencing. The methods developed and planned in this project are being adopted for implementation on portable microcomputers having sufficient memory, disk storage and speed to enable the use and display of videodigitized maps and other data requiring high spatial and color resolution. Special emphasis is given to the implementation of this methodology by those involved in the process of planning, recommending policy, or decision making. Once developed, the methodology will be applied to a number of existing groundwater contamination problems in cooperation with Cornell University Extension personnel and individuals in other organizations in the U.S. and abroad.
W83-02130

OPTIMAL REAL-TIME RESERVOIR SYSTEMS OPERATION: INNOVATIVE OBJECTIVES AND IMPLEMENTATION PROBLEMS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 4A.
W83-02142

CLUSTER MODEL FOR FLOOD PEAK ANALYSIS: APPLICATION TO LOWER OHIO RIVER BASIN,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2E.
W83-02143

DYNAMIC PROGRAMMING APPLICATIONS IN WATER RESOURCES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
S. Yakowitz.
Water Resources Research, Vol 18, No 4, p 673-696, August, 1982. 8 Fig, 6 Tab, 135 Ref.

Descriptors: Water resources development, Computers, *Reviews, *Dynamic programming, *Stochastic process, Probabilistic process, *Mathematical studies, Hydrologic models, *Model studies, Water quality, Irrigation, Reservoirs.

This survey reviews dynamic programming models for water resource problems and examines computational techniques which have been used to obtain solutions to these problems. Problem areas surveyed include aqueduct design, irrigation system control, project development, water quality maintenance, and reservoir operations analysis. Computational considerations impose severe limitations on the scale of dynamic programming problems which can be solved. Inventive numerical techniques for implementing dynamic programming have been applied to water resource problems. Discrete dynamic programming, differential dynamic programming, state incremental dynamic programming, and Howard's policy iteration method are among the techniques reviewed. Attempts were made to delineat the successful applications, and speculative ideas are offered toward attacking problems which have not been satisfactorily solved. (Baker-FRC)
W83-02147

PLANNING WATER REUSE: DEVELOPMENT OF REUSE THEORY AND THE INPUT-OUTPUT MODEL, VOL I: FUNDAMENTALS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
C. D . Turner, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175216, Price codes: A14 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 114, Colorado State University, Fort Collins, September 1980. 316 p, 45 Fig, 39 Tab, 97 Ref. OWRT C-80202-R(8818)(1), 14-34-0001-8818.

Descriptors: *Water reuse, *Municipal water, *Water plans, Water demand, Water law, Water transfer, *Colorado, Denver, Fort Collins, South Platte River, Basin, *Potable water, Public health, Treatment facilities, Model studies, *Input-output analysis, Water quality.

Municipalities in the west are searching for new sources of water at a time when very little undeveloped water remains. An increasing number of communities are planning to meet growing water needs through water reuse. In Denver, for example, a potable water reuse facility of 100 mgd is being planned for construction during the 1990's. An alternative to potable water reuse is the exchange of treated municipal wastewater for unused high-quality agricultural water. This type of water reuse promises to be less expensive than potable reuse, and it can be implemented today. In order to facilitate the exploration of municipal water reuse alternatives, a water reuse methodology is developed in the research. Two case study demonstrations are used to document the application of the methodology. The water reuse planning methodology is developed using: (1) a synthesis of reuse definitions from the literature; (2) an analysis of proposed and existing water reuse projects to discover new directions in reuse development; (3) identification of financial and regulatory incentives contained in the water quality laws; and (4) the identification of mechanisms in appropriative water law that influence water reuse. The resulting methodology is designed to aid in the formulation of water reuse alternatives. An economic methodology is also developed for the evaluation and comparison of dual purpose water reuse alternatives with other water supply and wastewater treatment alternatives. The South Platte River Basin and the cities of Fort Collins and Greeley are used to demonstrate the alternative development methodology. The demonstration shows that water reuse exchange with agriculture has the potential to meet all but the very highest municipal water projections for the next 40 years in the basin.
W83-02176

PLANNING WATER REUSE: DEVELOPMENT OF REUSE THEORY AND THE INPUT-OUTPUT MODEL, VOL II: APPLICATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. Klooz, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175224,

Group 6A—Techniques Of Planning

Price codes: A08 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 115, Colorado State University, Fort Collins, September 1980. 154 p, 19 Fig, 5 Tab, 26 Ref, 2 Append. OWRT C-80202-R(No. 8818)(1), 14-34-0001-8818.

Descriptors: *Water reuse, *Municipal water, *Water plans, Water law, *Water transfer, *Colorado, South Platte River Basin, Water quality, *Input-output analysis, *Water demand, Model studies, Drought, Cache la Poudre River basin.

In order to facilitate the exploration of municipal water reuse alternatives, a water reuse methodology and an input-output water balance model have been developed in the research. Case study demonstrations in the South Platte River Basin of Colorado are used to document the application of the methodology and the input-output water balance model. Volume I of the research develops the reuse planning methodology and applies the methodology in two case studies. The water reuse planning methodology is based on: (1) a synthesis of reuse definitions from the literature; (2) an analysis of proposed and existing water reuse projects to discover new directions in reuse development; (3) identification of financial and regulatory incentives contained in the water quality laws; and (4) the identification of mechanisms in appropriative water laws that influence water reuse. Volume II adapts basic input-output principles to the context of reuse in a water resources system. The depiction of water reuse by this methodology is based on two reuse schemes. One scheme focuses on the various reuse forms employed in a river basin. The other one depicts the water quality of the transferred and reused water and the water quality requirements of the use systems.
W83-02177

ESTIMATION OF GROUNDWATER RESOURCES ON THE BASIS OF DECISION-MAKING THEORY,
Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
For primary bibliographic entry see Field 4B.
W83-02252

LARGE-SAMPLE METHODS FOR DECISION ANALYSIS OF GAMMA VARIATES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
R. Krzysztofowicz, and S. Yakowitz.
Water Resources Research, Vol 16, No 3, p 491-500, June, 1980. 9 Fig, 6 Tab, 15 Ref.

Descriptors: *Statistical analysis, *Rainfall, *Decision making, *Bayes decision theory, *Gamma variables, Planning, Water management, *Arizona, Tucson.

Although the Bayes decision techniques are used for water resource management problems and the gamma variable is used to study hydrological phenomena, their concurrent use leads to computational difficulties. This paper shows how the problems may be circumvented by use of likelihood approximation techniques from optimal decision theory in conjunction with certain expansion formulas to obtain a multivariate normal approximation to the posterior law. The contour curves of the normal law are ellipses and are better suited to computer simulation than the exact posterior law. With moderate size data sets the approximate posterior is almost equivalent to the actual law. Examples analyzed were derived from winter rainfall data from Tucson, Arizona. (Cassar-FRC)
W83-02274

MULTIOBJECTIVE ANALYSIS OF MULTIRESERVOIR OPERATIONS,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. W-G. Yeh, and L. Becker.
Water Resources Research, Vol 18, No 5, p 1326-1336, October, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Multiobjective planning, *Reservoir operation, *Operating policies, Multireservoir networks, Multipurpose projects, Water management, Planning, Benefits, *California Central Valley Project, Optimization, Decision making.

Practical procedure for analyzing a multiple purpose, multiple facility reservoir system were developed for the purpose of optimizing system operation. In this study the 5 purposes or benefits treated as objectives were hydropower production, fish protection, water quality maintenance, water supply, and recreation. The constraint method was used to develop trade-offs and a specially modified linear programming and dynamic programming algorithm. The procedures were applied to the California Central Valley Project (9 storage reservoirs, 3 canals, 4 pumping plants, and 9 powerplants). Noninferior sets were obtained with each benefit parameterized singly and in various combinations. Two sets of monthly streamflows (one for a drought year and the other for an excess water year) were used to develop the corresponding noninferior sets. These procedures helped to allocate total benefits derived from the water resource and to operate the system with all constraints. This technique permitted a very high degree of decomposition of the noninferior policy set. Information was presented in a series of two-dimensional plots representing cross sections of the noninferior set. (Cassar-FRC)
W83-02348

MANAGING WATER RESOURCE SYSTEMS,
National Inst. for Training in Industrial Engineering, Bombay (India).
R. P. Mohanty.
Water Supply and Management, Vol 6, No 5, p 387-403, 1982. 4 Fig, 36 Ref.

Descriptors: *Systems analysis, *Water management, Management, Model studies, *Alternative planning, Long-term planning, *Management planning, Water resources development, Economic aspects, Social aspects, Decision making, Legal aspects.

A general model for management of water resource systems is proposed. The five constraining forces are external, process, technical, performance, and organizational. External constraints include the socioeconomic situation, political structure, public policies, legal system, cultural factors, and demand generating systems. For example, in very affluent communities and politically underdeveloped countries, management policies change very rapidly. An equilibrium policy is characteristic of a moderately affluent economy. Process constraints are inherent in the managerial functions. Technical constraints are imposed by technical and physical configuration of the system, for example, topographic conditions and agro-climatic conditions. Performance constraints arise from the standards against which system effectiveness are evaluated, such as economic efficiency or quality of life. Organizational constriants originate from conflicts among the different groups in the water resource organization: users, government, and production sector. Use of this model allows consideration of the dynamic and strategic issues and is appropriate for planning long-term growth. Traditional systems analysis techniques produce a series of alternative engineering estimates and do not resolve many of the diverse social and technical issues. (Cassar-FRC)
W83-02379

DEVELOPMENT AND OPERATIONAL STRATEGIES FOR WATER RESOURCE AND SUPPLY SYSTEMS,
T. Kitson.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 257-273, 1982. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Water demand, *Water management, *Water supply, Severn-Trent Water Authority, Model studies, Hydrologic models, Planning, Operating policies, Data collections, Water policy, Peak demand, Water use, Water storage, Water resources development, Reservoirs, Rivers, Groundwater, *England.

The present state of the art regarding practices and techniques used in water resource/supply analysis in the United Kingdom, in particular by the Severn-Trent (ST) Water Authority, is described. Basic data requirements for planning and day to day control, development strategy, factors influencing operational thinking in the 1980's are discussed. The academic aspect of time series information has developed to a greater degree than practical applications. ST uses a 15 station data bank containing records from 1932 to the present. Real-time flow forecasting models are under consideration. Water demand data was estimated by simple trend projection of total supply output prior to 1974. Forecasts are now based on newer methods which consider household, industrial-commercial-agriculture, and transmission loss and use and on the factors affecting use: weather and season. The analysis of the water system is based on a hierarchy of geographical units, dependent on access to water supply (Severn, river; East Midlands, reservoirs; and Upper Trent, groundwater). For modeling work 3 capacity parameters have been defined: maximum value that can be sustained for 3 or 4 weeks, a normal value that can be sustained for months, and minimum capacity. Proposed water storage schemes (Carsington Reservoir and Shropshire groundwater field) will increase the flexibility of water supplies. Interlinking among sources provides security in case of drought or short-term failure and increases efficiency in meeting demand. At present most links are on the local level. Rules for operating all strategic reservoir and river sources have been developed. ST has formulated standards for water resource/supply reliability. (Cassar-FRC)
W83-02387

6B. Evaluation Process

VALUATION AND ACQUISITION OF FLOODPLAIN LANDS FOR STREAM VALLEY PARKS,
Georgia Univ., Athens. Coll. of Business Administration.
For primary bibliographic entry see Field 6F.
W83-02140

SUPPLEMENTAL IRRIGATION OF HORTICULTURAL CROPS IN THE HUMID REGION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02172

COMPUTER-OPTIMIZED STORMWATER TREATMENT (COST) PROGRAM: PHILADELPHIA CASE STUDY,
CH2M/Hill, Gainesville, FL.
U. P. Singh, J. E. Scholl, and R. L. Wycoff.
Water Resources Bulletin, Vol 18, No 5, p 769-778, October, 1982. 8 Fig, 5 Tab, 9 Ref.

Descriptors: *Combined sewer overflows, *Storm wastewater, *Pollution load, Model studies, Water quality control, Wastewater treatment, Planning, Urban runoff, Runoff, Economic evaluation, Dissolved oxygen, Oxygen, Philadelphia, *Pennsylvania, Optimization, Water pollution control, Biological oxygen demand.

Two computer models, the Continuous Stormwater Pollution Simulation System (CPSS) and the Computer Optimized Stormwater Treatment Program (COST), were applied to the Philadelphia, Pennsylvania, urban area to aid in water quality planning. Results indicated that removing 5 million pounds of BOD from combined sewer overflows would reduce low dissolved oxygen events by the Delaware River Estuary by 107 hours per year; and removing 5 million pounds of BOD from storm water runoff, by 56 hours per year. Upstream flow (70 million pounds BOD per year) and wastewater effluents (60 million pounds BOD per year) account for the major portion of the 178 million pounds per year of BOD load. THe COST program provides a planning and conceptual design tool to identify the economically optimum combination of wet weather and dry weather po[l

lution abatement alternatives. CSPSS is a water quality model which relates pollutant loads to receiving water impacts. Selection of a water pollution control strategy can be based on evaluating the tradeoffs between total annual costs and receiving water improvements. (Cassar-FRC)
W83-02174

AN EVALUATION OF WATER CONSERVATION TECHNIQUES IN THE UPPER COLORADO RIVER BASIN,
Utah Water Research Lab., Logan.
R. Narayanan, and D. R. Franklin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175315, Price codes: A03 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Resources Planning Series UWRL/P-82/07, December 1982. 39 p, 4 Fig, 25 Tab, 30 Ref. OWRT B-185-UT(1), 14-34-0001-9137.

Descriptors: *Water conservation, *Colorado River, *Salinity standards, *Water quality standards, *Economic evaluation, Fossil fuels, Irrigation demand, *Water allocation, *Water demand, Cost-benefit analysis, Industrial potential.

The Upper Colorado River Basin contains large deposits of oil shale, tar sands, crude oil, coal, and natural gas. Agriculture still accounts for 90% of the water depletions, but future development of these energy resources is expected to take increasing amounts of water. A mixed-integer programming model was used to maximize returns to land, water, and mineral resources. The results were used to assess the need for government-sponsored water conservation measures to supplement water saving techniques employed by the private sectors in response to increased water prices. The feasibilities of various water saving techniques by industries and of various government-sponsored water conservation measures were examined within a benefit-cost analysis framework. The model is solved for 1974 data and for 1985 and 2000 with assumed water demand increases. The solutions indicate that public investments in water conservation measures are not economically justified by the water saved since the marginal value of water is less than the cost of conservation. However, where consequent reductions in downstream salinity levels are taken into consideration, the benefits exceed the cost of various conservation programs. However, even these benefits are insufficient to justify expanding the salinity control program to the level required to achieve EPA salinity standards.
W83-02186

ENERGY IMPACTS OF WATER BASED RECREATION,
Utah Water Research Lab., Logan.
J. C. Batty, D. A. Bell, E. B. Godfrey, C. Howell, and J. P. Riley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178152, Price codes: A04 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Resources Planning Series UWRL/P-82/09, December 1982. 46 p, 11 Fig, 12 Tab, 110 Ref, 1 Append. OWRT B-171-UT(1), 14-34-0001-9137.

Descriptors: Water resources development, Water management, *Energy, *Recreation demand, *Economic aspects, Planning, *Accounting, *Utah, Lake Powell.

The overall objective of the study reported here was to determine to what extent energy accounting could supplement and/or complement economic benefit/cost analyses of water management projects and to specifically examine the energy impacts of water based recreation. The energy accounting literature was carefully reviewed and an energy accounting methodology applicable to water management was devised. Data pertaining to recreation at five reservoirs in Utah were assembled from visitation records and on-site surveys. Energy requirements for site construction, travel to and from the recreation site, and recreation at the site were estimated. It was determined that energy devoted to water based recreation is not inconsequential. As much energy is devoted to recreation at Lake Powell alone as is required for all production agriculture in Utah. It is suggested that while the models developed in this study could be used with confidence in the preparation of energy impact statements the authors are not persuaded energy accounting provides additional information to water use planners beyond that obtainable from traditional economic analysis.
W83-02235

URBAN PLANNING CRITERIA FOR NON-POINT SOURCE WATER POLLUTION CONTROL,
Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W83-02317

ASSESSMENT OF THE STATE OF THE ART AND DEVELOPMENT OF PROPOSED IMPROVEMENTS IN RECREATION BENEFIT VALUATION FOR WATER RESOURCES PLANNING,
George Washington Univ., Washington, DC. Dept. of Engineering Administration.
R. C. Waters, and V. S. Moustakis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181974, Price codes: A03 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 43, Univ. of the District of Columbia, February 1983. 24 p, 22 Ref. OWRT A-018-DC(1), 14-34-0001-2109.

Descriptors: *Recreation benefits, *Recreational use, *Willingness-to-pay, *Contigency valuation method, Household production function, Option value, Willingness-to-sell, Unit-day-values, Travel cost method, Social aspects, Economic aspects, Pareto optimality, *Literature reviews, Criteria.

The objective of this study was to examine the issues related to the use of Willingness-to-Pay (WTP) based methods in evaluating recreational benefits. This research is a continuation of a research report 'An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning' available through NTIS (PB82-198003). A literature search was conducted and its results are reported. The major findings of the research include (1) the use of any WTP based method does not lead to Pareto optimal social arrangements, (2) WTP does not take into account that public resources are commonly owned, which means that each member of a society is an equal resource owner, (3) WTP is an income biased approach, (4) use of the WTP via the travel cost method assumes that a well defined individual (or household) recreation demand function exists, which is a herioc assumption, and (5) WTP is not compatible to the political process involved in recreation planning. The report concludes that the Unit-Day-Value method, although minimally treated in the literature, represents a robust alternative to recreation benefits evaluation, and it presents a framework for effective agency UDV implementation. Guidelines for additional research necessary for UDV derivation are provided.
W83-02323

ECONOMIC ASPECTS OF COST-SHARING ARRANGEMENTS FOR FEDERAL IRRIGATION PROJECTS: A CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W83-02327

ECONOMIC ANALYSIS OF ALTERNATIVE DOMESTIC WATER SUPPLIES,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
W. C. Nelson, and R. C. Coon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182113, Price codes: A03 in paper copy, A01 in microfiche. North Dakota Water Resources Research Institute, Fargo, Completion Report, July 1981. 35 p, 6 Fig, 8 Tab, 25 Ref. 1 Append. OWRT A-067-NDAK(1), 14-34-0001-0136.

Descriptors: *Water distribution, *Rural areas, *Domestic water, *Regional analysis, *Computer models, Simulation design, Groundwater, Water supply, Water delivery, *Alternative water supply, Linear programming, Montana, North Dakota, *Economic analysis, Great Plains.

The Great Plains Region has numerous domestic water supply problems due to insufficient and poor quality groundwater. This condition has led to rapid development of joint rural water systems. This project is Phase One of the development of a computerized model to design and evaluate alternative domestic water supply systems for rural areas. A linear programming model was modified to design a least cost water delivery network of underground pipe. It is operational and when combined with an elevation simulation model, designs a complete joint rural water system including the delivery network, pressure booster stations, reservoirs, pumps, and cost estimate for the entire system. The second part of the system, not currently operational, will analyze three additional means of supplying domestic water: (1) private individual wells; (2) hauling by truck; and (3) surface water collection and storage. Various treatment methods can be combined with any of the methods. The objective of the overall system is to be able to compare each of the four methods and combinations of the four methods on a regional basis. This may involve a joint rural water system servicing the higher population density areas and using truck deilvery and surface collection in low denisty areas of a region. Parts of the simulation model have been tested in a two-township region in North Dakota and a thirty-township region in Montana.
W83-02369

FACILITATION OF COMMUNITY ORGANIZATION,
Research Triangle Inst., Research Triangle Park, NC.
R. B. Isely, and C. R. Hafner.
Water Supply and Management, Vol 6, No 5, p 431-442, 1982. 3 Fig, 25 Ref.

Descriptors: *Developing countries, *Public participation, *Water management, Social aspects, *Community organization, Organizations, Water resources development, Management, Water supply, Sanitation, Maintenance, Public health, Benefits, Data collections, Rural areas, *Cameroon.

Water supply and sanitation programs in rural areas of developing countries do not succeed without community organization and involvement. A general description of a process for using and enhancing existing community organization for problem solving consists of 11 steps in the pathway toward stated objectives. Beginning with meeting leaders and information gathering, through defining problems and implementation of plans, the process ends with evaluation. The population must participate in an organized way in repair of water supply and sanitation facilities as well as in the proper use and protection of the water supply through the practice of proper personal and domestic hygiene. For successful community organization involvement four conditions are relevant: personnel trained in community diagnostic, supportive, and evaluative skills; information about the community; integrated approaches among sectors (public works, education, sanitation department, agricultural and home extension services, and health department); and technology and information suitable for the village's stage of development. Case histories from 2 villages in Africa illustrate three potential outcomes of facilitating community organization: reinforcement of local management capacities, enhancement of participation in the program, and increased probability of program success. (Cassar-FRC)
W83-02395

LEGAL AND ADMINISTRATIVE SYSTEMS FOR WATER ALLOCATION AND MANAGEMENT: OPTIONS FOR CHANGE. SEVEN PER-

SPECTIVES ON ASPECTS OF WATER RESOURCE PLANNING IN THE SOUTHEASTERN STATES,
Virginia Water Resources Research Center, Blacksburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187120, Price codes: A19 in paper copy, A01 in microfiche. Completion Report, March 1983. 418 p, 6 Fig, 9 Tab, 11 Append. Walker, W. R., Cox, W. E., and Hrezo, M. S., eds. OWRT B-123-VA(1).

Descriptors: *Water law, Water resources planning, *Planning, Water resources management, *Water management, *Decision making, Water management policy, Water policy, *Water allocation, Conjunctive management, Instream flow protection, Interbasin transfer, *Interjurisdictional transfer, *Riparian doctrine, Water quality, Water quantity, Water supply, Drought, *Southeast U.S.

This report analyzes seven aspects of water resources planning and management and their implications for the southeastern United States. Its purpose is to provide an assessment of alternatives for changes in the water law of the Southeast. 'Allocation of Supplies Among Competing Offstream Users Within the Basin' (99 footnotes) suggests that permit systems offer improved capability for balancing public and private interests in water but that this option may be too severe for states with a general abundance of water resources. Options assessed in 'Accommodating Interwatershed Transfer Under the Riparian Doctrine' (26 footnotes) include a declaration that any water use is protected from actions for damages in the absence of material injury, establishment of reasonableness as the sole criterion for evaluating the legal standing of a nonriparian use, adoption of a procedure for protecting inbasin water users, establishment of a water use reporting system, and creation of an arbitration board. 'Protection of Instream Flows' (81 footnotes) presents measures already in effect in some states and federal actions designed to protect minimum flows. 'Integration of Land and Water Management' (118 footnotes) suggests alternatives including consolidation of land and water management programs into a single administrative structure, comprehensive planning, and coordinated permitting. Optional institutional measures discussed in 'Conjunctive Management of Surface and Ground Water' (43 notes) are a legislative declaration that conjunction management is state policy, use of economic incentives to encourage conjunctive management, and reliance on water regulatory systems to conjunctively manage water resources. 'Integration of Water Quality Control and Water Quantity Management' (22 notes) focuses on four institutional options: statewide permitting, the capacity use area approach, the prior appropriation approach, and an approach based on the registration of water uses combined with a drought management strategy. 'Water Allocation During Water Shortages' (207 footnotes) discusses encouragement of water conservation through economic incentives and education, initiation of statewide planning for water shortage management, and implementation of a comprehensive shortage management program within the framework of water use permitting.
W83-02404

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FINANCING WATER RESOURCES: COST ALLOCATION, COST SHARING, INCENTIVES.
Georgia Univ., Athens. Inst. of Natural Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178145, Price codes: A07 in paper copy, A01 in microfiche. Proceedings, A Technology Transfer Workshop, Sept. 20-23, 1977, Jekyll Island, Ga. North, R. M., and Hanke, S. H., ed., June 1982. 116 p, 5 Fig, 6 Tab, 19 Ref. OWRT T-0016(6710)(1), 14-34-0001-6710.

Descriptors: *Financing, *Cost sharing, Revenue sharing, *Benefit sharing, *Cost allocation, *Pricing, Funding, Water projects.

These proceedings focus attention on the developing issues, problems and opportunities associated with financing and paying for the investments and costs of water resources project and programs. Selected participants prepared 17 papers on the problems of financing and cost sharing in water resources planning, implementation and operations. The 1976 Water Resources Council study on 'Planning and Cost Sharing Policy Options for Water and Related Land Programs' (P.L. 93-251, Sec. 80(c)) served as a focus for policy issues and researchable problems. The position papers and four workshop summaries included the following areas: (1) A history of Federal, non-federal cost sharing and financing arrangements, (2) the development of rationale (or theories) for cost sharing, (3) reports on the existing nominal and effective cost sharing rates for planning, construction and operations of surveys, projects and programs, (4) the development of alternative cost and sharing options.
W83-02234

COST INDEX TRENDS AND COMPARISONS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
B. M. Berthouex, and Y. Pathak.
Journal of the Water Pollution Control Federation, Vol 54, No 9, p 1331-1332, September, 1982. 1 Fig, 1 Tab.

Descriptors: *Costs, *Construction costs, Water pollution control, *Wastewater treatment plants, Buildings, Construction equipment.

Five cost indexes for pollution control projects increased by an average of 9-10% per year from 1971 to 1979, compared with about 3% from 1950 to 1970. These indexes were: U.S. EPA (small city conventional treatment, large city advanced treatment, and complete urban sewer systems), Marshall and Stevens equipment index, Chemical and Engineering index, and Engineering News-Record (separate indexes for construction and building). (Cassar-FRC)
W83-02285

ECONOMIC ASPECTS OF COST-SHARING ARRANGEMENTS FOR FEDERAL IRRIGATION PROJECTS: A CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Economics.
K. Ghebreyohannes, R. A. Young, and E. W. Sparling.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182014, Price codes: A04 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No 118, December 1982. 63 p, 3 Fig, 6 Tab, 23 Ref, 5 Append. OWRT A-015-COLO(2), 14-3-0001-3860, 4006, and 5006.

Descriptors: *Irrigation, *Economics, *Cost-sharing, *Water policy, *Costs, *Cost allocation, Federal project policy, *Colorado, Narrows project, Case studies.

The philosophy of the Reclamation Act of 1902 was that all reclamation project costs should be repaid in full except interest on construction costs. However, early reclamation cost-sharing policy was not successful in that repayments to the government fell short of planned levels. This led to a series of changes culminating with the Reclamation Act of 1939. It revised reclamation policy from total repayment of cost to repayment on an 'ability to pay' basis determined by USBR. Since that time charges for USBR-supplied irrigation water have not been required to reflect the cost of water supply. Consequently, there has been a growing concern with the degree to which reclamation irrigation projects are subsidized. Critics believe that it is unlikely that water users would agree to contract for reclamation projects if they were to bear full cost. The proposed Narrows Unit on the South Platte River in N.E. Colorado has been taken as a case study. A modeling approach is employed to measure ability to pay as compared with full cost and the USBR current charging procedures. Estimate of average benefit (1976 price levels) accruing with the advent of the Narrows Project is $44 per acre-foot in the case for which water is delivered to formerly non-irrigated lands. If the water were to supplement supplies on lands formerly inadequately irrigated, the estimated benefit is $32 per acre-foot. If lands had been adequately irrigated with groundwater, the net benefit would be about $8 per acre-foot (equivalent to the cost savings from replacing wells and pumps). Repayment capacity of the irrigation beneficiaries was computed on ability-to-pay criterion by USBR at $14.56 per acre-foot. However, the expected cost of irrigation water is estimated to be $63.49 per acre-foot of water received at farmers' headgates (also 1976 prices) if water users were to repay all costs allocated to irrigation purposes, including interest at 6-1/2%. Results show water price charged under ability-to-pay criterion reflects only a fraction of true cost. Water users could not profitably contract for USBR-supplied water if they were to bear full irrigation project costs.
W83-02327

OPERATION AND MAINTENANCE IN SURFACE IRRIGATION PROJECTS IN INDIA,
Asian Development Bank, Manila (Philippines). Irrigation Div.-1.
T. K. Jayaraman.
Water Supply and Management, Vol 6, No 5, p 405-415, 1982. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Operating costs, *Maintenance costs, *Irrigation programs, Planning, Gujarat State, *India, Surface irrigation, Budgeting, Costs, Economic aspects, Expenditures.

A study of operations and maintenance (O and M) expenditures for irrigation projects in India indicates that a large proportion of the limited funds for this purpose is used for salaries of temporary staff hired for seasonal repairs. Although governments and international funding agencies supply money for capital projects, allocation of money for O and M is usually neglected. O and M expenses were not separated into canal and head works or work-changed and regular establishment in most of the state budgets. Using Gujarat State as an example, O and M expenses were less than revenue earned from the projects for 7 of 11 years. Actual expenditures for this state were greater than the national average. Appropriate O and M expenditures for a given region may be calculated from a model, which depends on the gross irrigated area, O and M expenditures per ha of the potential area created, agricultural price index, year, and an error term. Several changes in policy are recommended: (1) provide more funds for physical repairs, keeping the salary component to a minimum, and (2) revise the accounting procedures so that O and M expenses are broken into appropriate categories, providing more statistics for planning and evaluation. (Cassar-FRC)
W83-02381

6D. Water Demand

COMMENT ON 'A REEVALUATION OF PRICE ELASTICITIES FOR IRRIGATION WATER' BY RICHARD E. HOWITT, WILLIAM D. WATSON, AND RICHARD M. ADAMS; AND REPLY BY AUTHORS,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
W. L. Martin, R. A. Selley, and D. C. Cory.
Water Resources Research, Vol 18, No 4, p 1302-1308, August, 1982. 5 Fig, 8 Ref.

Descriptors: *Irrigation, *Pricing, *Estimating, Mathematical studies, Linear programming, Quadratic programming, Computers, *Water demand.

In this comment on the cited research (Water Resources Research, Vol 16, No 4, p 623-628, 1980) the current authors take exception to the interpretation given to a crucial equation presented. The original research tried to demonstrate that the use of quadratic programming rather than linear programming in estimating the derived demand for irrigation water will yield more elastic

estimates of demand. The empirical example as used purports to demonstrate these results, which are claimed on the basis of a mathematical proof to be conceptually correct. During the examination of the mathematical proof the current authors found what they describe as an error in the interpretation given to a specific equation. In the reply by the original authors an attempt is made to discuss the pertinence of the theoretical results developed in both papers, to demonstrate that in the multioutput case considered the original conclusion has a strong intuitive basis and is in agreement with the main theoretical conclusion reached by the reviewer, and to show that the empirical result is credible and represents the actual marginal revenue product schedule for water. (Baker-FRC)
W83-02164

SPATIAL UTILIZATION OF VERMONT LAKES BY RECREATIONAL BOATERS,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 6E.
W83-02183

THE WATER REQUIREMENTS AND POLLUTANT POTENTIAL IN THE GASIFICATION OF CARBONACEOUS SHALES,
Utah Water Research Lab., Logan.
J. A. Cissell, V. D. Adams, J. E. Fletcher, D. S. Filip, and D. B. George.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177964, Price codes: A04 in paper copy, A01 in microfiche. Utah Water Research Laboratory Water Quality Series UWRL/Q-82/04, October 1982. 59 p, 12 Fig, 14 Tab, 50 Ref. OWRT A-043-UT(1), 14-34-0001-9047.

Descriptors: Carcinogens, Cooling water, *Coal gasification, *Lignite, *Utah, *Process water, *Shales, Water pollution sources, *Water requirements, *Synthesis gas, Carbonaceous shales, Industrial water.

The Upper Colorado River Basin has vast deposits of lignaceous shales which now go largely unused but could potentially provide a valuable product through gasification. The technical feasibility of applying gasification processes currently used for coal, the water requirements of gasification in an arid climate, and potential pollution problems were examined through a series of laboratory studies. The results indicate that a synthesis gas, consisting primarily of hydrogen and carbon monoxide, can be produced from carbonaceous shales. Heating values ranged from 4 to 62% of that of gas obtained from coal with the percentage largely determined by the amount of intermixed organic material. Optional process water use was estimated. The shales require additional cooling water for ash quenching. Process and cooling water requirements both ran 5 to 15% higher than those for coal. Quantities of phenols, ammonia-N, and total organic carbon produced were significantly less for the shales tested than for the coal. Differences in process condensate constituents, such as mutagenicity and trace elements, were also determined for the coal and shale samples. Results varied widely with the chemical characterization of the coal and shale.
W83-02211

THE ROLE OF WATER RESOURCES IN THE LOCATION OF SOUTH CAROLINA INDUSTRY,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
B. L. Dillman, J. S. Lytle, W. E. Twilley, Jr., and P. C. Luisa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181982, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Completion Report No 98, December 1982. 54 p, 2 Fig, 5 Tab, 57 Ref, 1 Append. OWRT A-039-SC(1), 14-34-0001-6042.

Descriptors: *Industrial development, Industrial water, Entropy, *Regional analysis, Regression analysis, *Industrial location, Gravity models, Potential models, Manufacturing, *South Carolina, Water pollution control.

Population potential, a distance-weighted measure of human resource and market potential mass, was used in a prediction model for plant locations and as a criterion for separating existing plants into categories for testing hypotheses about water related manufacturing industries in South Carolina. It was found that concentration, as measured by an entropy model, has occurred since 1970 for heavy water users and other manufacturing plants, but that the concentration is much more dramatic for the heavy water users. This concentration was more noticeable as population potential increased, except for the highest population potential class where concentration was presumably intense already. The occurrence of federal water pollution legislation and increases in stream standards, around 1970, has altered the relative desirability of locating on flowing streams. There now is a tendency for new plants to locate near urban areas and near other plants to take advantage of the many benefits of more concentrated factor markets and urban amenities afforded by more densely populated areas and(or) to have access to urban water and waste treatment systems.
W83-02324

DEVELOPMENT AND OPERATIONAL STRATEGIES FOR WATER RESOURCE AND SUPPLY SYSTEMS,
For primary bibliographic entry see Field 6A.
W83-02387

CHANGES AND PROCESSES OF WATER RESOURCE DEVELOPMENT AND FLOOD CONTROL IN POST-SECOND WORLD WAR JAPAN,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
Y. Takahasi.
Water Supply and Management, Vol 6, No 5, p 375-386, 1982. 5 Fig, 10 Tab.

Descriptors: Environmental effects, *Water demand, Water resources developement, Eutrophication, Levees, Water pollution effects, Multipurpose reservoirs, *Japan, Dam effects, Social impact, Water use, Recreation, *Flood control, Urbanization, Industrial development, Municipal water.

Water demand in Japan has increased dramatically since the end of the World War II. Development of water resources to meet the increased household and industrial consumption and to control floods has resulted in significant environmental changes. Projects included construction of multipurpose reservoirs, saline water barriers in river mouths, river levee systems, flood control dams, and river works. At present 2060 dams exist, compared with 781 in 1930. Urbanization and industrialization have also had a great impact on flooding and water quality. Some of the negative impacts are: larger floods with increased peak discharges and flood wave velocities, more urban property vulnerable to flood damage, increased sedimentation rate in reservoirs, scouring of river beds near bridges and weirs, coastal erosion, river water quality deterioration (eutrophication and increased turbidity), damage to fisheries, changes is scenery, impairment of recreation, disappearance of brooks, and displacement of people by filling reservoirs. (Cassar-FRC)
W83-02393

6E. Water Law and Institutions

ON THE MUTUALLY BENEFICIAL COOPERATIVE SCHEME: DYNAMIC CHANGE IN THE PAYOFF MATRIX OF INTERNATIONAL RIVER BASIN SCHEMES,
Waterloo Univ. (Ontario). Dept. of Geography.
C. M. Dufuornaud.
Water Resources Research, Vol 18, No 4, p 764-772, August, 1982. 6 Fig, 5 Tab, 22 Ref.

Descriptors: *Water management, *International agreements, Resources management, Water supply, Water resources development, River basins, Economic aspects, Riparian rights, Water rights, Columbia River Basin, Lower Mekong River Basin.

Mutual benefit is the most common criterion by which scholars view international cooperative river basin schemes. Possibilities open to riparian parties in the Columbia and Lower Mekong River Basin schemes are explored by demonstrating the various dynamic paths of the net benefits of such cooperative and sovereign schemes. The analysis as given suggests a substantial preoccupation on the part of the riparians with the economic gains from cooperation, providing that these are certain. In the Columbia there is good reason to suggest that the negotiations demonstrated a willingness on the part of Canada to settle for less than it could have obtained. In the Mekong the gains from joint development required cooperation of a long-term nature, an event not realistic in the political climate of the time. From a managment perspective it is noteworthy that nations negotiate positions they desire on the basis of the criterion of mutual benefit, providing that it holds under the circmstances that they perceive to be important. (Baker-FRC)
W83-02160

SPATIAL UTILIZATION OF VERMONT LAKES BY RECREATIONAL BOATERS,
Vermont Univ., Burlington. School of Natural Resources.
A. H. Gilbert, J. J. Lindsay, R. E. Manning, and M. B. Lapping.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-175281, Price codes: A09 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Univ. of Vermont, Burlington, December 1982. 92 p, 4 Fig, 23 Tab, 30 Ref, 3 Append. OWRT A-043-VT(1).

Descriptors: Lakes, *Recreation, *Boating, Aerial photography, *Lake management, *Vermont, Lake Champlain, Waterbury Reservoir, Public access areas, *Recreation demand, Surveys, *Recreation facilities, Holding tank facilities, Sanitory facilities.

Research was initiated in the summer of 1980 to assess the status of boating activity on Vermont lakes. Objectives of the study were to determine the nature and extent of boating-related problems and to develop recommendations for their resolution. The geographic focus of the study was Lake Champlain and Waterbury Reservoir. Study methods included aerial photography of boating activity, surveys of lake boaters, shoreline owners and marina operators, and a literature review of water-based recreation laws, regulations and management alternatives. Major boating-related problems and issues were found to be lack of adequate access and berthing capacity, insufficient holding tank pump-out facilities, conflicts between boaters and shoreline residents, and the special importance of 'near-shore' waters for boating activity. Major recommendations include development of a more active information/education program for boaters, state registration of non-power boats, additional reliance on provisions of the Shoreland Zoning Act and Mooring Management Act to ensure a more coordinated approach to lake management, state requirements for pump-out facilities at marinas which service boats with on-board sanitary facilities, and development of several different types of public access areas.
W83-02183

STATUTORY RECOGNITION OF INSTREAM FLOW PRESERVATION: A PROPOSED SOLUTION FOR WYOMING,
R. A. Thompson.
Land and Water Law Review, Vol 17, No 1, p 139-154, 1982. 65 Ref.

Descriptors: *Water law, *Instream flow, *Appropriation, Legal aspects, *State jurisdiction, *Wyoming.

Although Wyoming has not yet joined other western states in recognizing the value of dedicating water to in-stream uses through the enactment of

statutes providing for instream flows for fish, wildlife, and recreational purposes, there is increasing concern regarding this issue in the state. The Wyoming legislature has considered several bills addressing instream flow, but none have passed. A review of the problems of preserving instream flows under the existing appropriation doctrine demonstrates that the major doctrinal barriers are the requirement for an actual diversion of water and for application of the water to a beneficial use. None of the methods available for protecting instream flows under existing Wyoming law are wholly satisfactory. It is suggested that instream flow legislation designed to protect instream uses in Wyoming without harming existing water users include designation of instream flows for fish and wildlife preservation as a beneficial use; elimination of the actual diversion requirement; granting of instream flow appropriations only to public, as opposed to private, entities; specification that the instream flow appropriation does not carry with it the power of condemnation; creation of an Instream Flow Commission charged with handling administrative responsibilities; and provision for public hearings with respect to the determination of the minimum stream flows to be appropriated. (Carroll-FRC)
W83-02190

CASE NOTES,
J. F. Araas.
Land and Water Law Review, Vol 17, No 1, p 155-168, 1982. 84 Ref.

Descriptors: *Legal aspects, *Judicial decisions, *Water rights, Appropriation, *Indian reservations, *Indian water rights, Colville Indian Reservation, *Washington.

In 1981, the Ninth Circuit Court of Appeals reversed the decision of the district court which held that an individual Indian Tribal member allotted a portion of the tribal land could not transfer the 'full' amount of his reserved water rights to a non-Indian purchaser. The appellate court found that the Indian allottee could transfer his implied reserved water rights to the non-Indian purchaser and that the purchaser acquires the Indian allottee's priority date both with respect to the amount of water appropriated by the Indian at the time of the conveyance and with respect to the amount of water that the non-Indian purchaser appropriates with reasonable diligence after passage of the title to the land. The case, Colville Confederated Tribes v. Walton, has been appealed to the Supreme Court. The Colvilles contend that the Tribe's reserved water rights are superior to the non-Indian purchaser's rights and that there is an insufficient amount of water to satisfy both parties' needs. The ruling by the Court of Appeals appears to contravene the principles established in Winters v. the United States (1908) and subsequent Supreme Court cases. Established law dictates that the transferability of the Indian allottee's reserved water rights be limited to situations that would continue to fulfill the purposes of the Colville reservation. In addition, a balancing of equities would show that, while the Indian allottee and the non-Indian purchaser would benefit, both the tribe and other non-Indian appropriators would be adversely affected by transfer of the 'full' amount of the Indian allottee's reserved water rights. Substantial consideration should be accorded to the interests of the tribe, since the water was impliedly reserved to fulfill the purposes of the reservation. (Carroll-FRC)
W83-02191

NO FEDERAL COMMON LAW OF NUISANCE FOR WATER POLLUTION,
N. R. Long.
Natural Resources Journal, Vol 22, No 2, p 441-454, April, 1982. 99 Ref.

Descriptors: *Water pollution control, *Legislation, *Federal jurisdiction, Wastewater effluent, Wastewater disposal, Water pollution sources, Milwaukee, Illinois, Federal common law.

In a dispute between the State of Illinois and the City of Milwaukee, the Supreme Court, in 1972, proclaimed a 'federal common law of nuisance' action for alleged discharges of inadequately treated or untreated sewage into Lake Michigan. The State of Illinois had claimed that overflow discharges from Milwaukee, Wisconsin sewage systems along with inadequately treated sewage from the two treatment plants in Milwaukee had become a health threat to Illinois' citizens. Illinois also stressed that the sewage was accelerating the eutrophication of Lake Michigan. Shortly after the 1972 decision, Illinois sued Milwaukee under federal common law to abate the alleged public nuisance. Federal Water Pollution Control Act Amendments of 1972 and 1977 both caused significant changes in the situation. Milwaukee obtained permits for its sewage discharges, but was unable to comply with the permit requirements. In 1977 the state court issued a judgment and set a timetable within which Milwaukee had to comply with its permits. Illinois proceeded in its action, and the suit eventually culminated in a ruling based on the federal common law of nuisance. The district court rejected Milwaukee's claim that the FWPCA preempted the federal common law and ordered the City to cease discharging raw sewage into Lake Michigan. The Supreme Court reversed the lower federal courts and overruled the 1972 decision. As a result, federal common law remedies for environmental torts will not be available if Congress has legislated a comprehensive regulatory scheme for a particular subject area. (Baker-FRC)
W83-02200

MINERAL DEVELOPMENT AND THE COASTAL AREAS,
Alabama Univ., University. School of Law.
H. Cohen.
Journal of Energy Law and Policy, Vol 3, No 1, 1982. p 113-168, 144 Ref. OWRT B-080-ALA(2).

Descriptors: *Coasts, *Resources development, *Estuaries, *Legal aspects, *Oil industry, *Alabama, Legislation, Jurisdiction, Institutional constraints, Wetlands, Environmental effects, Saline water intrusion, Water quality.

Alabama is used as a specific example of the impact that mineral development, especially oil and gas drilling and production, may have on our coastal and estuarine zones, and the methods being used to deal with the problem. Oil and gas development affects the coastal environment through such activities as maintenance dredging, pipeline operations, drilling operations, and the installation of permanent structures. A primary concern associated with oil and gas operations in the coastal zone of Alabama is the potential damage to fresh water resources; dredging, canal construction, fresh water withdrawals from aquifers, and underground disposal of salt water produced concurrently with oil and gas may permit the invasion of salt water and pollution of fresh water. The Alabama legislature first passed its Coastal Area Act in 1973; that act was repealed and a new act was passed in 1976. In both statutes a Coastal Area Board was created, and the Board given very broad powers. It acts as a restraining element along the coast and tries to maintain the status guo in water and land use quality. Perhaps the most basic source of control over the coastal areas is found in the Army Corps of Engineers' jurisdiction. The large number of agencies concerned with the coastal area in many states tends to blunt the possibility of direct and comprehensive regulation of the coastal zone. Further, federal and state authorities divide the jurisdiction in such a manner that there will be continuing litigation. The clash between public control and private ownership of coastal areas and wetlands may never admit of a completely satisfactory solution. (Moore-SRC)
W83-02226

ALTERNATIVE STRUCTURES FOR WATER RIGHTS MARKETS: OVERVIEW AND HYPOTHETICAL CASE STUDY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. W. Eheart, R. M. Lyon, and B. D. C. Wong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178095, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center Publication No 174, Univ. of Illinois, Urbana-Champaign, January 1983. 76 p, 11 Fig, 2 Tab, 29 Ref, 4 Append. OWRT A-109-ILL(1), 14-34-0001-2115.

Descriptors: *Water rights, *Markets, *Water permits, Economics, Riparian rights, *Alternative water use, Cost effectiveness, *Cost repayment.

Although there has been general interest in the use of systems of transferable water rights to increase efficiency and flexibility of present water allocation systems, there has been relatively little research into the specific details of these market systems. The design of systems of marketable permits for water consumption from natural water courses was examined through a qualitative overview and a quantitative quasi-empirical, quasi-hypothetical case study. The most important considerations of the study were associated with the uncertainty of future streamflows and economic conditions, locational issues, and efficient and effective functioning of the markets. Particular attention was given to the problem of implementing marketable rights systems in regions presently following the riparian doctrine. In these regions the most important design decisions include the basis of definition of permits, the means for initially distributing them, the type of market mechanism used for their transfer, and the restrictions placed on their use and transfer. Two market systems were assessed and compared with two alternative nonmarket systems and to an optimal scheme. The market systems recoup about 95% of the optimal distribution.
W83-02229

LEGAL AND ADMINISTRATIVE SYSTEMS FOR WATER ALLOCATION AND MANAGEMENT: OPTIONS FOR CHANGE. SEVEN PERSPECTIVES ON ASPECTS OF WATER RESOURCE PLANNING IN THE SOUTHEASTERN STATES,
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 6B.
W83-02404

6F. Nonstructural Alternatives

VALUATION AND ACQUISITION OF FLOODPLAIN LANDS FOR STREAM VALLEY PARKS,
Georgia Univ., Athens. Coll. of Business Administration.
C. F. Floyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173310, Price codes: A05 in paper copy, A01 in microfiche. Georgia Institute of Technology, Environmental Resources Center Report Number ERC 01-82, Atlanta, June 1982. 75 p, 4 Maps, 5 Plats, 30 Ref. OWRT B-127-GA(1), 14-34-0001-7100.

Descriptors: *Acquisition, *Appraisals, Dedication, *Flood plains, *Flood plain zoning, *Land use, Land use controls, Mandatory dedication, Valuation, *Georgia, Athens, Sandy Creek Greenway, *Parks.

As more and more communities have become aware of the economic and environmental benefits arising from the protection of floodplains, interest has risen in the concept of stream valley parks. Acquisition of land for these parks can take several forms, including purchase and gifts, fee simple acquisition or easements. No matter what the method of acquisition, an appraisal of the real estate interests being acquired will almost always be required. The appraisal of floodplain lands for recreational purposes raises many questions and problems for appraisers. Among these are (1) basic conflicts between public and private benefits in the appraisal concept of highest and best use; (2) a lack of comparable sales for floodplain land and difficulties in adjusting to adequately reflect the value of floodplain lands; (3) the necessity to consider the impact of floodplain, mandatory dedication of parkland, and other land use controls, and; (4) the absence of data concerning the impact on value of

remaining lands from the acquisition of trail easements.
W83-02140

REDUCING FLOOD INSURANCE CLAIMS THROUGH FLOOD WARNING AND PREPAREDNESS,
Flood Loss Reduction Associates, Palo Alto, CA.
H. J. Owen, M. Wendell, J. Jorgenson, and M. Hughes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-181784, Price codes: A05 in paper copy A01 in microfiche. Report, April 1983. 83 p, 8 Fig, 11 Tab, 37 Ref, 2 Append. OWRT C-00005-G(No 1433)(1), 14-340001-1433.

Descriptors: *Flood plan insurance, *Flood forecasting, *Warning systems, *Insurance, Flood damage, *Flood protection, *Non-structural alternatives, Economics, Flood plains, River forecasting.

A preliminary evaluation was made of the engineering, legal, economic and institutional aspects of offering a differential in flood insurance rates for communities having flood warning and preparedness programs. Investigation focussed on: 1) whether administratively operable minimum criteria could be developed for judging the potential effectiveness of local flood warning and preparedness programs; 2) the extent of incentive to implement and operate a flood warning and preparedness program that would be provided to communities by various rate differentials; 3) the broad national costs and benefits of stimulating the implementation and operation of local flood warning and preparedness programs; 4) the appropirate roles and relationships of the National Weather Service, the Federal Emergency Management Agency and other agencies with missions related to implementation and operation of the concept; and 5) the nature of the modifications to existing statutes that would be necessary to implement the concept. The report concludes that the concept of offering a rate differential to encourage development of local flood warning and preparedness programs has sufficient merit to warrant detailed investigation.
W83-02319

ECONOMIC POTENTIALS FOR MANAGING NUTRIENT LOSS WITH ALTERNATIVE IRRIGATION TECHNOLOGIES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. J. Vaux, Jr., and B. K. Stevens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-187112, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, March 1983. 26 p, 19 Ref. OWRT-B-029-CAL(1).

Descriptors: *Input-output analysis, Economic aspects, Nonpoint pollution sources, *Nitrates, Alternative planning, *Taxes, *California, San Joaquin Valley, *Nutrient loss, *Pollution taxes, Residual charges, *Effluent changes.

The objective was to examine the economic properties of input taxes and alternative production technologies as instruments for controlling nonpoint source pollutants. A theoretical analysis demonstrates that input taxes have the economic properties of residuals charges. The use of alternative production technologies is not a promising method of controlling effluents when compared with pollution taxes. Even though inputs may be used more efficiently with new production technologies, controlling technology does not control the quantity of inputs used. The empirical research on nitrate-nitrogen controls in the southern San Joaquin Valley confirms the interchangeable nature of input large and residuals charges. Some evidence supporting the second hypothesis was also found since the social costs of requiring sprinkler irrigation were nearly twice the social cost of an equivalent pollution penalty. Furthermore, the results indicated that nitrate losses from cropping activities in some parts of the Central Valley may not be very large. (Snyder-California)
W83-02403

6G. Ecologic Impact Of Water Development

A FAUNAL AND SEASONAL STUDY OF THE AQUATIC INSECTS IN TWO WATER ECOSYSTEMS IN SOUTH ARKANSAS - DEGRAY RESERVOIR AND THE UPPER CADDO RIVER,
Arkansas Water Resources Research Center, Fayetteville.
R. T. Allen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-173187, Price codes: A03 in paper copy, A01 in microfiche. Publication No 88, October 1982. 22 p, 18 Tab. OWRT A-046-ARK(1), 14-34-0001-8004.

Descriptors: Aquatic animals, *Aquatic insects, *Ecosystems, *Aquatic habitats, Impoundments, Biota, Seasonal, Reservoirs, Data collections, Systematics, Taxonomy, DeGray Reservoir, Upper Caddo River, *Arkansas.

The impounding of the lower Caddo River to create DeGray Reservoir radically changed the water habitats in that portion of the Caddo River. A number of new and different habitats were created by the lake. The objective of this study was to determine what, if any, differences existed between the aquatic insect biotas of DeGray Reservoir and the upper Caddo River. Four collecting stations along the shore of DeGray Reservoir and four stations along the upper Caddo River were selected as sampling sites. Collections were made at one month (March, April, October, November) intervals, or at two week intervals (May, June, July, August, September) from March to December, 1979. The data collected indicate that the upper Caddo River is approximately three times as rich in the diversity of taxa collected and the number of individuals collected as DeGray Reservoir.
W83-02127

INTERACTIVE MODELING AND DATA MANAGEMENT FOR PREDICTING SURFACE AND GROUNDWATER QUALITY AND QUANTITY,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 6A.
W83-02130

ECOLOGY AND PATHOLOGY OF WILDLIFE IN RESPONSE TO SPRAY IRRIGATION OF CHLORINATED SEWAGE EFFLUENT-PHASE II,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 3C.
W83-02135

COMMENT ON 'STREAM SYSTEM EVALUATION WITH EMPHASIS ON SPAWNING HABITAT FOR SALMONIDS' BY MOSTAFA A. SHIRAZI AND WAYNE K. SEIM; AND REPLY BY AUTHORS,
Oregon State Univ., Corvallis. Dept. of Forest Engineering.
R. L. Beschta.
Water Resources Research, Vol 18, No 4, p 1292-1298, August, 1982. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Spawning, *Sedimentation, *Fisheries, Land use, Water pollution effects, Silt, Sediment concentration, Gravel, Habitats, Aquatic habitats, Environment.

In this comment on the cited research results (Water Resources Research, Vol 17, p 592-594, 1981) the current authors take some exceptions to the findings of the earlier investigators, with particular concern being shown in the area of an index of gravel composition. The present authors suggest that other than in rare instances the textural composition of spawning gravels in natural streams cannot be accurately represented by a lognormal distribution, and thus the d-g statistic can only be used as an indicator. Although the d-g index of spawning gravel quality appears strongly correlated with percent survival of fish embryos, it is apparently an insentive indicator of instream changes in gravel composition as a result of land use activities. Thus its usefulness for monitoring changes in the quality of spawning gravel in streams affected by management activities is questionable. Estimates of both the central tendency and the variance of sediment particle sizes in a spawning gravel sample are needed to obtain a more complete description of total sediment composition than can be provided by d-g or percent fines alone. The fredle index appears to combine both types of information. (Baker-FRC)
W83-02163

ENVIRONMENTAL FEATURES FOR FLOOD CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
F. D. Shields, Jr.
Water Resources Bulletin, Vol 18, No 5, p 779-784, October, 1982. 21 Ref.

Descriptors: *Environmental effects, *Channel improvement, *Flood control, *Reviews, Channel morphology, Stream improvement, Flood channel, Open channels, Low Flow, Excavation, Floodways, Vegetation, Water control, Oxbow lakes, Meanders, Aquatic habitats, Aquatic life, Habitats, Literature review.

A review of available information on the environmental effects of flood control channel modifications reveals that some recent projects have features designed to avoid or minimize adverse affects. Those projects which have successfully preserved or enhanced environmental values used a multidisciplinary approach from the beginning of the planning process. Some typical methods, techniques, and features used to enhance environmental quality in flood control channels are selective clearing and snagging, nonuniform channel geometries, aquatic habitat restoration and improvement, special treatments for excavated material, and revegetation. In selective clearing only the trees and obstructions causing significant problems are removed. Heavy equipment is used sparingly to minimize damage to banks, stream beds and vegetation. Nonuniform channel geometrics avoid the environmental impacts of straight trapezoidal channels. These include modifications on one bank only, often alternating banks to preserve trees to take advantage of hydraulic factors. Floodways can be constructed so that the existing stream serves as a low flow channel within an excavated high flow channel. (Cassar-FRC)
W83-02166

PUBLIC ATTITUDINAL FACTORS IN RIVER DEVELOPMENT AND CONSERVATION IN THE UPPER MISSISSIPPI RIVER REGION,
Missouri Univ.-Columbia. Dept. of History.
S. L. Flader, and P. V. Scarpino.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-177923, Price codes: A11 in paper copy, A01 in microfiche. Missouri Water Resources Center, Columbia, Completion Report, December, 1982. 246 p, 216 Ref. OWRT B-138-MO(1), 14-34-0001-0269.

Descriptors: *Attitudes, *Conservation, *Environmental change, *History, *River development, Hydroelectric power, Locks and dams, Mussels, Navigational improvements, Nine-foot channel, Pearl button industry, Pollution, Resource policy, Water power, Wetlands drainage,*Mississippi River, *Minneapolis/St. Paul, *Keokuk Dam, *Lake Cooper, Winneshiek Bottoms, St. Louis.

The report analyzes the dynamic relationship between public and interest group attitudes, river development policies, and environmental change in the upper Mississippi River basin, principally in the period 1890-1945. Focussing on such developments as the Keokuk, Iowa, hydroelectric project, mussel propagation for the pearl button industry, wetlands drainage, establishment of the Upper Mississippi River Wildlife and Fish Refuge, the nine-foot

channel with its series of locks, dams, and pools, and the problems of pollution and pollution control (especially in Minneapolis/St. Paul and St. Louis), the study considers the social, economic, and attitudinal milieu of new developments and the responses of various interest groups to resulting changes in the river environment. By clarifying the long-term relationship between changing attitudes, river development, and conservation, the study provides perspective on the human factor in river management and planning.
W83-02207

MINERAL DEVELOPMENT AND THE COASTAL AREAS,
Alabama Univ., University. School of Law.
For primary bibliographic entry see Field 6E.
W83-02226

THE USE OF INVERTEBRATE INDICATORS FOR ECOLOGICAL RESILIENCY EVALUATION OF A FLOW REGULATED RIVER,
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. F. Haber, and M. A. Brusven.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178087, Price codes: A05 in paper copy, A01 in microfiche.
Idaho Water and Energy Resources Research Institute Completion Report, Univ. of Idaho, Moscow, December 1982. 84 p, 36 Fig, 5 Tab, 15 Ref. OWRT B-049-IDA(1), 14-34-0001-9111.

Descriptors: *Regulated flow, *Benthic insects, *Benthic colonization rates, Indicators, Flow, Velocity, Substrate, Water temperature, *Species richness, Density, Rating curves, Hydro-peaking management, Resiliency, *Idaho, Clearwater River, *Bioindicators, Carrying capacity.

A systems approach was used to determine certain biological and physical indicators which were used to characterize the benthic ecosystem in the Clearwater River below Dworshak Dam, Idaho. Using these indicators, a Hectare-Day Index was developed that resulted in a quantitative measure of impact of regulated flow on the benthic system. For three selected periods, Summer 1978, Fall 1978 and Spring 1981 the reduction in the Hectare-Days Index when compared to an idealized constant flow for the same period was: 3.1% for the spring period, 5.5% for the summer and 5.5% for the fall period. The analysis of field tests over the period 1977 through 1980 indicated mean insect density and species richness decreased as depth increased from < 60 to > 300 cm; the density and richness increased from velocities of < 6 cm/sec to > 60 cm/s; in the Clearwater River where cobbles, boulders and sand represented over 95% of the dominant particle sizes among the various habitats. The rate of insect colonization on a sterile substrate was used to predict carrying capacity for main stem Clearwater River. Sixty days was predicted time required to attain full carrying capacity in the regulated reach. By point of contrast 47 days were required for the unregulated reach (Middle Fork).
W83-02228

LAKE ECOSYTEM RESPONSE TO FISH MANAGEMENT--A STEADY-STATE MODELING INVESTIGATION,
Maine Univ. at Orono. Land and Water Resources Center.
M. L. Hutchins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-178103, Price codes: A03 in paper copy, A01 in microfiche.
Completion Report, December 1982. 24 p, 4 Fig, 1 Tab, 24 Ref, Append. OWRT A-056-ME(1), 14-34-0001-2121.

Descriptors: *Algal control, Aquatic populations, *Ecological effects, *Fish management, Mathematical models, Water quality management, *Lake ecosystems, Model studies, *Input-output analysis.

An input/output steady-state model descriptive of a simple five-component lake ecosystem was used to investigate possible long-term ecosystem response to selected fish management practices. In particular, the response of game fish and algal standing crops to various fish manipulations is explored. Results indicate that it may be physiologically possible for simple lake ecosystems to exist in either of two distinctly different states of equilibrium--a predator-dominated system in which algal standing crop is controlled primarily by predation, or a nutrient-limited system in which algal standing crop is controlled primarily by phosphorus inflow. In a predator-dominated system, any fish manipulation which in the long term increases game fish standing crop will also increase algal standing crop. In a nutrient-limited system, any forage fish perturbation which increases game fish standing crop will also increase algal standing crop, but game fish perturbations which benefit game fish should decrease algae. In general, harvesting game fish stimulates game fish production, while stocking game fish suppresses production. Stocking game fish appears justified only in situations of overharvest, and then only in amounts which exactly cover the excess harvest.
W83-02230

COMPARISON OF CENTRAL ASIAN CANALS AND THE SOUTHERN PART OF THE DIVERSION ROUTE OF SIBERIAN WATERS,
Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
For primary bibliographic entry see Field 4A.
W83-02257

CHANGES AND PROCESSES OF WATER RESOURCE DEVELOPMENT AND FLOOD CONTROL IN POST-SECOND WORLD WAR JAPAN,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W83-02393

7. RESOURCES DATA

7A. Network Design

INTERVENTION ANALYSIS WITH MISSING DATA,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Water Resources Research, Vol 16, No 1, p 159-171, February, 1980. 5 Fig, 6 Tab, 12 Ref.

Descriptors: *Data collections, *Time series analysis, *Intervention analysis, Mathematical equations, Mathematical models, Monte Carlo method.

Intervention analysis of environmental quality data is often limited by missing data. Whereas hydrologic and meteorological data sets are usually long and complete, environmental data sets are likely to be incomplete because of difficulty in collecting samples in extreme weather or the expense of some sophisticated analytical procedures. Two approaches for estimating missing data, one of which provides minimum variance estimates when model parameters are known, and a computationally simpler approximation were investigated. The approximation was found to quite adequate and was incorporated in a practical scheme to estimate missing data and model parameters simultaneously. Subsequently, a method for estimating the parameter variance for use in significance tests on the intervention magnitude was investigated. The adequacy of the approximation was assessed in a series of Monte Carlo tests using three models consisting of step, linear, and impulse decay trends in mean with residual lag 1 Markov noise. Results of the experiments indicated that the suggested method provides adequate estimates of the variance of the intervention magnitude of the step and impulse decay models but that the variance was substantially overestimated for the linear model. However, for the same proportion of missing data the accuracy of the approximation improved as the sample size increased. (Cassar-FRC)
W83-02275

A REGIONAL OCEAN MONITORING PLAN,
Southern California Coastal Water Research Project Authority, Long Beach.
W. Bascom.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p. 39-44.

Descriptors: *Municipal wastewater, *Monitoring, *Water quality standards, *Data collections, *Water analysis, Water quality, Research priorities, Specifications, Testing procedures, Outfall, Ocean dumping.

The EPA is about to permit the discharge of wastewater not subjected to secondary treatment under the 301h waiver plan into southern California's coastal waters. The author suggests the use of the Regional Ocean Monitoring Plan (ROMP) as a means to standardize sampling, preparation and analysis techniques. ROMP proposes specific ways in which monitoring can be more valuable and cost-effective. The proposed techniques include: sampling stations that are more evenly distributed; measurements at multiple control stations; bridging stations between outfall-affected areas; standardized equipment; standardized forms, charts, processing, archiving and data storage, analysis techniques and reporting procedures; computer storage of data by contributor; consistent personnel training; quality control procedures; and measurement of actual toxicity of all effluents after normal dilution. Research on future monitoring should proceed concurrently with the proposed monitoring. The objectives of the research would include developing better techniques for measuring and evaluating sub-lethal effects on marine environments; predicting changes in the biota; detecting the presence of new chemicals; analyzing data from a long-term viewpoint; continuing development of taxonomic identification procedures; counting small animals more accurately; and measuring subsurface currents. Few monitoring programs have adequately established clear objectives in advance. ROMP demonstrates that more useful data can be obtained at less cost if monitoring programs are modified in accordance with scientific findings. (Atkins-Omniplan)
W83-02302

VARIATION IN BENTHIC ASSEMBLAGES,
Southern California Coastal Water Research Project Authority, Long Beach.
B. E. Thompson.
In: Coastal Water Research Project, Biennial Report for the Years 1981-1982, Willard Bascom, ed. p. 45-58, 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Benthic environment, *Sampling, *Biological samples, *Outfall, *Biological properties, Species composition, Biomass, Sediment sorting, Pollution load, Contamination, Biological oxygen demand, Volatile solids, Chromium.

Changes in biological assemblages caused by effluent discharge can only be interpreted if the natural fluctuations in existing assemblages are known. The purposes of this study were to examine variation in the composition levels, and to determine the number of replicate grab samples necessary in future sampling to detect assemblages changes. It was assumed that a gradient of biological changes results from a gradient of outfall conditions. Measurements of three sediment paramters at 36 sites were made from grab samples collected concurrently with samples used for biological information. Total variable solids (TVS) wa used as a measure of organic material, biological oxygen demand (BOD) as a measure of microbial respiration, and chromium as a measure of general contamination. A general outfall gradient was quantified and divided into control, transition and contaminated zones. The most abundant species in each zone was usually distinct. Variation in numbers of species and individuals was highest in contaminated zone samples. Trends in species composition, numbers of species, individuals, and biomass along a generalized outfall gradient were similar at both the kilometer and meter sampling scales; however, the sample variation at the smaller scale was less variable. Changes in species composition of assemblages along outfall gradients can be seen with single samples and with replicated grab sam-

ples, but dichotmous sampling programs are suggested. (Atkins-Omniplan)
W83-02303

7B. Data Acquisition

PASSIVE MICROWAVE SENSING OF SOIL MOISTURE UNDER VEGETATION CANOPIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, and J. R. Wang.
Water Resources Research, Vol 18, No 4, p 1137-1142, August, 1982. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Remote sensing, *Vegetation effects, *Soil moisture, Moisture availability, Vegetation, Environmental effects, Microwave sensing, Radiometers, Measuring instruments.

A procedure is developed for quantifying the effect of a vegetation canopy on the passive microwave emission from the soil. A theoretical model was used as the basis of a parametric model of the vegetative effect. The parametric model uses a single vegetation parameter, vegetation water content or wet biomass, which can also be estimated from remotely sensed data. Data collected over small plots, by using truck-mounted passive microwave radiometers were used to calibrate the parametric model and evaluate aspects of the theoretical model. Results show that a microwave radiometer operating at a 21-cm wavelength can provide volumetric surface soil moisture estimates to about 5% of accuracy for fields covered with moderate vegetation. In addition, all of the data required for applying the parametric model can be measured by remote sensing. (Baker-FRC)
W83-02146

A MODIFIED VACUUM-PRESSURE LYSIMETER FOR SOIL WATER SAMPLING,
Morrison and Associates, Inc., Newport Beach, CA.
R. D. Morrison.
Soil Science, Vol 134, No 3, p 206-210, September, 1982. 3 Fig, 22 Ref.

Descriptors: *Sampling, Soil properties, *Lysimeters, Leaching, Calcium, Chlorides, Iron, Magnesium, Manganese, Sodium, Lead, Zinc, Clogging, Design criteria, *Soil pore water sampling.

Soil pore water samples are collected by moisture extraction of a soil core or with in situ samplers. Lysimeters are the most common samplers, despite a number of inherent and sampler related problems. Sampler limitations were minimized through the design and construction of all-Teflon units for shallow and deep sampling. Design features in both units include detachable threaded components, the placement of the hydrophilic section midway on the vessel, and the ability to assemble a unit in the field best suited to the particular soil conditions. Leaching of Ca, Cl, Fe, Mg, Mn, Na, Pb, and Zn standards through the porous Teflon revealed no detectable attenuation. Clogging of the porous section occurred, although the proper installation and back-filling with silica flour minimized this effect. (Baker-FRC)
W83-02197

AN IMPROVED CORER FOR SOFT SEDIMENTS,
Southern California Coastal Water Research Project Authority, Long Beach.
W. Bascom, J. Mardesich, and H. Stubbs.
In: Coastal Water Research Project, Biennial Report for the years 1981-1982, Willard Bascom, ed. p 267-271, 2 Fig, 2 Ref.

Descriptors: *Cores, *Bottom sampling, *Sediments, Core drilling, Mud, Aquatic soils, Tubes.

For certain specific purposes it is essential to have precise and undisturbed cores of soft sediments as much as one meter long. The box corer is the best known device, but because of its weight can be unmanageable and dangerous on ships under 20 meters long. This project required a lighter more easily handled device. Three features make the tool that was designed particularly effective. First is its triggering mechanism: when an advance weight touches bottom a lever is released that allows the weighted core barrel to fall the final meter and the tin-edged barrel cuts into the mud with an equivalent weight of 900 kilograms, if taking a 30 meter long core. Second, to ensure that the tube holding the core remains tightly sealed, a rubber seal, coated with silicone at the top lid and at the disconnect joint, was designed which prevents air or water leaks. Third, was a design to hold the top lid completely open to prevent shock waves from disturbing the top surface of the sediments. Taking the core is instantaneous and automatic. To date, 40 cores have been taken in water dpeths of 30 to 500 meters with about 95% success. The longest core taken was 84 centimeters at a depth of 500 meters. This corer is lighter and less expensive than the box corer, but produces cores that are qualitatively the same. In 1981, a comparison was made between this corer and a box corer at one Los Angeles County Sanitation District. The muds were compared for copper contest. The results were equivalent and the LACSD adopted this device for future surveys. (Atkins-Omniplan)
W83-02310

MODELING OF THE MELTING OF SNOW IN MOUNTAINS AND ARRIVAL OF WATER ON THE DRAINAGE BASIN SURFACE WITH THE USE OF SATELLITE INFORMATION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2C.
W83-02419

RADAR AND INFRARED REMOTE SENSING OF GEOTHERMAL FEATURES AT PILGRIM SPRINGS, ALASKA,
Alaska Univ., Fairbanks. Geophysical Inst.
K. G. Dean, R. B. Forbes, D. L. Turner, and F. D. Eaton.
Remote Sensing of Environment, Vol 12, No 5, p 391-405, 1982. 7 Fig, 25 Ref.

Descriptors: *Infrared imagery, *Remote sensing, *Geothermal studies, *Radar, Pilgrim Springs, *Alaska, Hot springs, *Thermal springs, Aircraft, Geologic fractures, Radiometry, Kigluaik Fault, Kuzitrin Fault.

Thermal anomalies and structural elements in the Pilgrim Springs area of Alaska were studied using radar and thermal data collected during high-altitude (60,000 ft) aircraft flights in July 1980. Like-polarized imagery was more effective in delineating significant linears than cross-polarized imagery. Many linears corresponded with known fractures and/or faults, which may be conduits for hot springs. Although the linears showed a wide range of orientation, significant concentrations were parallel to the trends of the Kigluaik and Kuzitrin faults. High-altitude thermal imagery, usable only on a smaller site-specific project rather than a regional study, detected anomalies associated with geothermal heat sources. Results were obtained by density-slicing analysis of evening imagery, since data collected in daytime were useless. A temperature difference of at least 2 C was required for recognition of a warm area. Most of the warm areas detected were lakes and streams. However, 3 major areas of warm ground in known hot spring regions were revealed by thermal imagery. (Cassar-FRC)
W83-02450

7C. Evaluation, Processing and Publication

FLOW-DURATION DATA FOR MISSOURI STREAMS,
Geological Survey, Rolla, MO. Water Resources Div.
L. D. Hauth.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $26.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1189, 1982. 201 p, 2 Fig, 1 Tab.

Descriptors: *Flow duration, *Streamflow, *Data collections, Streams, Gaging stations, Sites, Hydrographs, Missouri.

Flow-duration data have been developed at 175 streamflow-gaging stations in Missouri that have at least 9 years of record. The flow duration is determined on a daily basis for period of record and presented as tables and hydrogrphs. The computation periods are 9, 19, 29, 39, or 49 years, depending on the length of continuous-streamflow records at each station. (USGS)
W83-02110

WATER RESOURCES DATA, HAWAII, WATER YEAR 1981. VOLUME 1. HAWAII.
Geological Survey, Honolulu, HI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-134791, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Data Report HI-81-1, 1982. 266 p, 14 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii.

Volume 1 of water resources data for the 1981 water year for Hawaii and other Pacific Areas consists of records of stage, discharge, and water quality of streams; and water levels and water quality in wells and springs. This report contains discharge records for 106 gaging stations; water quality for 11 gaging stations, 103 partial-record flow stations, and 150 wells; and water levels for 21 observation wells. Also included are 106 crest-stage partial-record stations and 19 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W83-02111

BASE FLOW OF STREAMS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W83-02112

WATER RESOUCES DATA, ALABAMA, WATER YEAR 1981.
Geological Survey, Tuscaloosa, AL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132035, Price codes: A24 in paper copy, A01 in microfiche. Geological Survey Water-Data Report A1-81-1, 1982. 540 p, 7 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes Reservoirs, Wells, Water level, Data collections, Sites, *Alabama.

Water resources data for the 1981 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 104 gaging stations, stage only for 16 gaging stations, stage and contents for 12 lakes and reservoirs, water quality for 75 gaging stations and 54 wells, and water levels for 53 observation wells. Also included are 19 crest-stage partial-record stations, 9 flood hydrograph partial-record stations, and 88 water-quality partial-record stations. Additional water

data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W83-02119

WATER RESOURCES DATA, CONNECTICUT, WATER YEAR 1981.
Geological Survey, Hartford, CT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-144352, Price codes: A15 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CT-81-1, 1982. 325 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Connecticut.

Water Resources Data for the 1981 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 55 gaging stations; storm discharge at 7 gaging stations; tidal volume at 1 gaging station; contents at 35 lakes and reservoirs; water quality of 40 gaging stations, 4 lakes and reservoirs, 2 harbors, and 16 wells; and water levels at 58 observation wells. Also included are 43 crest-stage partial-record stations. Additional water data were collected at various sites involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological survey and cooperating State and Federal agencies in Connecticut. (USGS)
W83-02120

WATER RESOURCES DATA, GEORGIA, WATER YEAR 1981.
Geological Survey, Doraville, GA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127837, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report GA-81-1, 1982. 446 p, 9 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Georgia.

Water resources data for the 1981 water year for Georgia consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records of 109 gaging stations; stage for 10 gaging stations; stage and contents for 17 lakes and reservoirs; water quality for 22 continuous stations, 131 periodic stations and miscellaneous sites; peak stage and discharge only for 106 crest-stage partial-record stations and 4 miscellaneous sites; measurements of discharge at 25 low-flow partial-record stations and 57 miscellaneous sites; and water levels of 28 observation wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Georgia. (USGS)
W83-02121

WATER RESOURCES DATA, MISSOURI, WATER YEAR 1981,
Geological Survey, Rolla, MO. Water Resources Div.
Geological Survey Water-Data Report MO-81-1, 1982. 394 p, 3 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water level, Data collections, Sites, *Missouri.

Water resources data for the 1981 water year for Missouri consist of records of stage, discharge, and water quality of lakes and reservoirs. This report contains records for water discharge at 124 gaging stations; stage and contents at 7 lakes and reservoirs; and water quality at 33 gaging stations (including 1 lake). Also included are data for 30 crest-stage, 11 water-quality partial-record stations, and 20 low-flow partial-record stations. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Missouri. (USGS)
W83-02122

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981. VOLUME 2. MISSOURI RIVER BASIN,
Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-140236, Price codes: A22 in paper copy, A01 in microfiche. Geological Survey Water-Data Report ND-81-2, 1982. 492 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *North Dakota, Missouri River basin.

Water resources data for the 1981 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 2 of this report contains 78 gaging stations; stage only records for 17 gaging stations; stage and contents for 7 lake and reservoirs; water quality for 55 gaging stations, 14 partial-record stations, 12 lakes, and 63 wells; and water levels for 14 observation wells. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State ad Federal agencies in North Dakota. (USGS)
W83-02123

WATER RESOURCES DATA, INDIANA, WATER YEAR 1981.
Geological Survey, Indianapolis, IN. Water Resources Div.
Geological Survey Water-Data eport IN-81-1, 1982. 448 p, 6 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Indiana.

Water resources data for the 1981 water year for Indiana consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 195 gaging stations, stage and contents for 12 lakes and reservoirs, releases from 6 flood-control reservoirs, water quality for 51 gaging stations, and water levels for 84 observation wells. Also included are 95 crest-stage partial-record stations and 42 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Indiana. (USGS)
W83-02124

WATER RESOURCES DATA, KANSAS, WATER YEAR 1981.
Geological Survey, Lawrence, KS. Water Resources Div.
Geological Survey Water-Data Report KS-81-1, 1982. 566 p, 10 Fig, 6 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Kansas.

Water resources data for the 1981 water year for Kansas consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 153 gaging stations, stage and contents for 22 lakes and reservoirs, water quality for 75 gaging stations, and water levels for 481 observation wells and water quality for 319 wells. Also included are data for 91 crest-stage partial-record stations. All data in this report represent that part of the National Water Data System operated by the U. S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS)
W83-02125

VARIABILITY OF PRECIPITATION IN THE PACIFIC NORTHWEST: SPATIAL AND TEMPORAL CHARACTERISTICS,
Portland State Univ., OR. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W83-02178

EVAPOTRANSPIRATION ESTIMATES BASED ON SURFACE TEMPERATURE AND NET RADIATION: DEVELOPMENT OF REMOTE SENSING METHODS,
Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W83-02185

USERS MANUAL FOR COMPUTER MODEL TO PREDICT TOTAL ENERGY REQUIREMENTS OF IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W83-02225

ECOLOGICAL CHARACTERIZATION OF THE CENTRAL AND NORTHERN CALIFORNIA COASTAL REGION; VOLUME IV, WATERSHEDS AND BASINS.
Jones and Stokes Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 2L.
W83-02311

WATER QUALITY MANAGEMENT STUDIES, LAKE SEMINOLE, FEBRUARY-DECEMBER 1979, PHASE II.
Water and Air Research, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5G.
W83-02312

PRECIPITATION CHARACTERISTICS AFFECTING HYDROLOGIC RESPONSE OF SOUTHWESTERN RANGELAND,
Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2B.
W83-02316

8. ENGINEERING WORKS

8A. Structures

SYSTEM OF FREEZING AND THERMOSTATING HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8C.
W83-02108

COUPLED DYNAMIC BEHAVIOUR OF REALISTIC ARCH DAMS INCLUDING HYDRODYNAMIC AND FOUNDATION INTERACTION,
Queen Mary Coll., London (England).
B. Nath, and S. G. Potamitis.
Proceeding of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 3, p 587-607, September, 1982. 15 Fig, 3 Tab, 28 Ref.

Descriptors: *Arch dams, *Reservoirs, *Hydrodynamics, Dam foundations, Dam design, Dam construction, Construction, Engineering, Mathematical equations.

A study is presented of the coupled dynamic behavior of realistic arch-dam reservoir systems, including both reservoir-dam and dam foundation interaction. The dam is assumed to be of circular cylindrical shape and located in a V-shaped valley, the acuteness of the V depending on the shape parameters of the dam. Novel mapping finite elements are used to represent the solid and the fluid aspects of the system. Results indicate that, depending on the overall stiffness of the dam, its coupled natural frequencies, mode shapes and response are influenced by hydrodynamic and foundation interaction. Also the effect of water compressibility is found to be small, so that it may be neglected in most arch-dam reservoir systems. The mapping finite element, used to represent the dam and its foundation, gives significantly better accuracy than when standard finite elements are used. (Baker-FRC)
W83-02201

AN APPROACH TO ASSIGNING THE MAXIMUM WATER DISCHARGE WHEN DESIGNING MAJOR HYDRAULIC STRUCTURES,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
T. F. Makarova, and L. F. Sotnikova.
Water Resources, Vol 9, No 1, p 27-31, January/February, 1982. 3 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No 1, p 61-65, January-Feburary, 1982.

Descriptors: *Design floods, *Dam design, Streamflow, Floods, Flood peak, Hydraulic structures, Guarantee corrections, Statistical analysis.

Guarantee correction values are introduced into calculations for maximum discharges of hydraulic structures of the first class of importance, i.e., structures whose failure would result in catastrophic damages and many deaths. This results in design discharges considerably greater than those for a structure whose failure would not cause a catastrophe. Values of the guarantee corrections are usually associated with the probable errors in the estimate of the corresponding maxima. The introduction of differentiated values of the guarantee corrections permits a more valid approach to assigning the design maximum discharge. (Cassar-FRC)
W83-02254

THE IRVINE VALLEY SEWER SEA OUTFALL TUNNEL,
K. I. M. Henry, and G. I. McCall.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 4, p 389-298, 1982. 7 Fig, 2 Tab.

Descriptors: *Outfall sewers, *Sewers, *Tunnel construction, Diffusers, Hydraulic structures, Grouting, Excavation, Outfall, Construction, Tunnel linings, Linings, Tunneling, Scotland, Firth of Clyde, Irvine Bay.

Tunneling was the method chosen for constructing a sea sewage outfall in Irvine Bay, Firth of Clyde, Scotland. Completed in 1979, the outfall comprises two 1118 m OD cement-mortar lined steel pipes encased in concrete infill within precast concrete segments. The driven tunnel, 3.2 m inside diameter, is 2000 m long, 1500 m of which lies below the low water mark. One pipe has 9 diffuser upstands 300 mm diameter, each with four 140 mm ports. The other pipe has a terminal upstand 860 mm in diameter with two 250 mm ports and two 300 mm ports. The tunnel was driven with a machine at the average rate of 2.9 m per shift of 10-11 hours (24 hour, 5 day work week) through fractured sandstones, shales, mudstones, coal, and fireclay. For igneous rock, traditional drill and blast methods were used, achieving 1.7 m per shift. Average progress was 15.9 m per week, maximum, 49 m per week. Bad weather at sea frequently delayed work on the offshore works. (Cassar-FRC)
W83-02389

UNIFORM FLOW OVER SKEW SIDE-WEIR,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 4A.
W83-02400

8B. Hydraulics

ENVIRONMENTAL FEATURES FOR FLOOD CONTROL CHANNELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6G.
W83-02166

ADDITION TO TABLES OF ORDINATES OF THREE-PARAMETER GAMMA DISTRIBUTION,
Vologda State Water Management Planning Inst. (USSR).
M. M. Polyakov, and L. Kh. Vyazalov.
Water Resources, Vol 8, No 4, p 369-372, July/August, 1981. 2 Tab, 4 Ref. Translated from Vodynye Resursy, No 4, p 67-70, July/August, 1981.

Descriptors: *Variation coefficient, *Probability distribution, *Parameter hydrology, Hydrologic equation, Hydraulics, Skewness coefficient.

Tables of ordinates for three parameter gamma distributions, used in calculating probability curves in hydraulic engineering practice, are extended beyond the usual range of Cs = 1 to 4 times Cv, where Cs = coefficient of skewness and Cv = coefficient of variation. Parameters are given for Cs = 0, -Cv, and -Cv for Cv values of 0.1-0.5 and for Cs = 5Cv and 6Cv for Cv = 1.0-2.0. (Cassar-FRC)
W83-02239

HYDRAULIC INVESTIGATIONS BY NUMERICAL METHODS,
All-Union Planning, Surveying and Scientific-Research Inst., Moscow (USSR).
V. M. Lyatkher, and A. N. Militeev.
Water Resources (English Translation), Vol 8, No 3, p 247-262, May/June, 1981. 7 Fig, 36 Ref. Translated from Vodnye Resursy, No 3, p 60-79, May/June, 1982.

Descriptors: *Mathematical equations, *Hydraulics, Equations, Flow, Flow characteristics, Hydrodynamics, *Turbulence.

The idea of spatial averaging of flows and appropriate equations before performing the operation of probability averaging is presented. It appears during this study that the practical use of the equations obtained, regardless of the flow regime (laminar or turbulent), is posible with the introduction of a smaller number of assumptions and a smaller number of relatively simpler (directly measurable in experiment) empirical functions. The proposed approach does not completely solve the problem of turbulence, but it does permit taking definite steps in describing its low frequency, long-wave anisotropic component, which is most interesting in many engineering applications. (Baker-FRC)
W83-02242

A NOTE OF CHANGES IN CHANNEL GEOMETRY AT TRIBUTARY JUNCTIONS,
Hull Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W83-02288

THE TRANSIENT RESPONSE OF COOLING PONDS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams.
Water Resources Research, Vol 18, No 5, p 1469-1478, October, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Cooling ponds, *Powerplants, *Hydraulic transients, Ponds, Stratification, Flow rate, Temperature effects.

Cooling ponds are a form of closed cycle cooling used for steam-electric power plants. Because of their thermal inertia they provide an advantage over cooling towers in filtering fluctuations in intake temperature, which results in improved plant efficiency. By using linear systems theory, the transient behavior of various types of ponds is analyzed in response to periodic meteorological conditions (characterized by equilibrium temperature) and plant operational conditions (characterized by condenser temperature rise). Frequency response is expressed in terms of dimensionless ratios involving frequency of input forcing, characteristic hydraulic residence and surface response times, and appropriate mixing parameters. Results are also interpreted with respect to physical design variables, such as pond area, depth, degree of stratification, intake submergence, discharge entrance mixing, condenser flow rate, and temperature rise. While the nature of the sensitivity can be identified using the analysis, real optimization in terms of the physical design variables requires detailed physical model tests under controlled conditions and verification under less controlled, but more realistic, field conditions. (Baker-FRC)
W83-02350

8C. Hydraulic Machinery

SYSTEM OF FREEZING AND THERMOSTATING HYDRAULIC STRUCTURES,
P. M. Glamazdin, A. F. Zaichenko, and B. I. Lavrinenkoy.
Hydrotechnical Construction, Vol 15, No 12, p 772-774, December, 1981. 1 Fig, 2 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 12, p 38-39, December, 1981.

Descriptors: *Hydraulic engineering, *Construction, Dams, *Temperature control, Freezing, Thawing, Temperature, Thermostatic control, Frozen ground, Thermosiphons.

At present two types of dams are used for permanently frozen ground on the basis of construction and operating experience - warm and frozen. When operating, warm dams permit thawing of the frozen ground of the foundation and thawing of the body of the dam. Impermeability of such dams is provided by watertight elements. The impermeability of frozen dams is created by freezing the earth of the foundation and dam. Artificial freezing devices, including thermosiphons, columns and brine systems, are the means of freezing soils. A system for storing cold has been developed which makes it possible to freeze and maintain a negative temperature in the structure within the prescribed limits during the entire period of operation. The system consists of a cold-storage tank and two levels of vapor-liquid thermosiphons filled with ammonia or Freon. For practical realization of the freezing and thermostating system it is necessary to solve a number of engineering problems: selection of the material for the storage tank, methods of building up the length of the thermosiphons, and

repair of individual components of the system. (Baker-FRC)
W83-02108

TIDAL POWER GENERAL UTILIZING ATMOSPHERIC PRESSURE OR AIR RECIRCULATION,
B. Jhun.
Water Resources Bulletin, Vol 18, No 5, p 885-888, October, 1982. 4 Fig.

Descriptors: *Tidal energy, *Hydroelectric plants, *Powerplants, Tidal powerplants, Atmospheric pressure, Air recirculation.

A tidal power generation method based on atmospheric pressure or air recirculation is also applicable to low head (< 10 m) hydroelectric power generation. The structures designed to use atmospheric pressure include two pools of differing heights separated by a dam and connected by an inverted U-tube which acts as a siphon. An air tube at the top of the discharge side allows small bubbles to enter, converting the potential energy of water into kinetic energy of air for operating air turbines. For producing power by air recirculation the same two pools, dam, and siphon tubes are used, with addition of pressure chambers with movable piston tops. The pressure chambers operate out of phase, creating a continuous air flow for driving air turbines. (Cassar-FRC)
W83-02169

A FOURTH UNIT FOR THE MAYFIELD HYDRO PROJECT,
A. C. Herstrom, L. A. Polivka, and R. B. Russell.
International Water Power and Dam Construction, Vol 34, No 7, p 36-40, July, 1982. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Model studies, *Hydraulic machinery, *Electrical equipment, *Hydroelectric power, Dams, Computer models, Hydraulic equipment, Electric power production, Financing, Construction costs, Fisheries.

A model study was conducted to maximize the use of available water on the Cowlitz River and to eliminate problems anticipated with the addition of a new unit to the Mayfield hydroelectric power plant. The model was calibrated for the existing geometry and flow conditions using field test data with a range of flow conditions. Computer models were used to study the upsurge in the forebay following a load rejection of all four units. The units are controlled from a duplex switchboard. A new line was installed from a new transformer with a new 230 kV circuit-breaker in the switchyard to connect the fourth generator. A contract was signed by the Washington Department of Fisheries and Game and City of Tacoma to maintain salmon and chinook populations at pre-dam levels. These environmental interventions caused some delay in licensing and engineering. Monthly meetings were held to closely manage the project. To finance the project and other improvements, the City of Tacoma borrowed $38 million. (Geiger-FRC)
W83-02223

THE ROCK ISLAND SECOND POWERHOUSE,
Stone and Webster Engineering Corp., Boston, MA.
For primary bibliographic entry see Field 8E.
W83-02373

8D. Soil Mechanics

THE MIXED GAMMA MODEL FOR CHANNEL LINK LENGTHS,
State Univ. of New York at Buffalo. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W83-02145

8E. Rock Mechanics and Geology

THE ROCK ISLAND SECOND POWERHOUSE,
Stone and Webster Engineering Corp., Boston, MA.
A. S. Lucks, C. A. Foster, T. J. Lyman, J. L. Rosenblad, and R. J. Conlan.
International Water Power and Dam Construction, Vol 34, No 7, p 25-29, July, 1982. 5 Fig.

Descriptors: *Dam construction, *Cofferdams, *Hydroelectric plants, Excavation, Rock excavation, Electric powerplants, Rock mechanics, Hydroelectric power, Spillways, Dams, Columbia River.

Before construction of the second powerhouse at the Rock Island hydroelectric facility on the Columbia River could be started, upstream and downstream cofferdams had to be built. Construction on the cofferdams was completed in June of 1975. The subsurface conditions of the second powerhouse foundation are described. The upstream embankment cofferdam was designed to be constructed underwater, while the downstream cellular cofferdam consisted of fourteen sheetpile cells and connecting arcs. Periodic maintenance of the cofferdams was required. To construct the second powerhouse, a right abatement fish ladder, right bank non-overflow section and retaining wall, and several spillways had to be demolished. Rock excavation and reinforcement and protection are discussed. The cofferdams performed well for over two and a half years. The sealing of the embankment by the underwater dumping of fine-grained non-plastic soils is very effective when a differential head can be established across the embankment during placement of the seal. (Geiger-FRC)
W83-02373

8F. Concrete

INVESTIGATIONS OF THE CHARACTERISTICS OF ELASTICITY AND CREEP OF CONCRETE IN THE ANDIZHAN RESERVOIR DAM,
I. E. Pukhov, and G. N. Kuleshov.
Hydrotechnical Construction, Vol 15, No 12, p 743-749, December, 1981. 3 Fig, 8 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroite'stvo, No 12, p 21-25, December, 1981.

Descriptors: *Dams, *Design criteria, *Creep, *Concrete, *Elasticity, Temperature effects, Seasonal variations, Reservoirs, Andizhan Reservoir Dam, *USSR, Uzbekistan, Karadarya River.

The concrete buttress dam of the Andizhan reservoir, with a height up to 117 m and 3.8 million cubic meters of concrete, was constructed on the Karadarya River in Uzbekistan. A characteristic of the coarse aggregate for the concrete is the presence in it of slabby and acicular gravel in an amount up to 40%. Along with studying the characteristics of elasticity and creep of the concrete, studies were also made of its strength indices and unit weight. The rate of increase of the modulus of elasticity of concrete at an early age directly in the dam depended on the ambient temperature associated with exothermic heating of the cement in the concrete, season of concreting and other factors. The values of the modulus of elasticity of concrete placed at various times of the year equalize with increasing age of the concrete. The moduli of elasticity of concrete at a late age obtained on large laboratory specimens and directly in the structure are close in value. The creep of concrete of massive structures depends on the ambient temperature and, consequently, on the season of placing the concrete in the structure. Under the same temperature conditions, creep of concrete directly in the structure and of large laboratory specimens is close in value. (Baker-FRC)
W83-02107

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DIRECTORY OF UNIVERSITY WATER EXPERTISE IN THE DISTRICT OF COLUMBIA - 1982,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and L. C. Salvo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180315, Price codes: A03 in paper copy, A01 in microfiche. D.C. Water Resources Research Center Report No 40, September, 1982. 39 p. OWRT A-999-DC(4), 14-34-0001-0109.

Descriptors: *Universities, *Scientific personnel, *Laboratories, *Training, *Evaluation, *Water expertise education information dissemination, University research, *District of Columbia, Research facilities, Grants, Technology transfer.

The directory of university water expertise serves to help dissmeninate information on the water and water resources of the District of Columbia. The directory was assembled for several purposes including: (1) to identify as nearly as possible all the faculty members of unversities in the District of Columbia who are actively involved in one or more aspects of water and/or water resources (86 faculty members were identified), 2) to facilitate communication among faculty members with water expertise and interests, so that duplication of effort can be minimized. The information on which this directory is based was obtained from the faculty member him/herself. Questionnaires were sent to all university faculty in the District of Columbia known to be involved in water and/or water related research activities. The directory is composed of three sections: (1) an alphabetical list of faculty members, (2) a cross-index in which faculty are categorized by their area/s of water expertise, (3) a second cross-index in which faculty are listed according to their university affiliation.
W83-02294

9C. Research Facilities

DIRECTORY OF WATER-RELATED ORGANIZATIONS IN THE DISTRICT OF COLUMBIA,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and L. C. Salvo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-180323, Price codes: A05 in paper copy, A01 in microfiche. District of Columbia Water Resources Research Center Report No 41, November 1982. 63 p. OWRT A-999-DC(5), 14-34-0001-0109.

Descriptors: *Federal government, *States government, *Jurisdiction, Employment opportunities, Social paricipation, Federal-state water rights conflicts, *Institutes, Research and development, *Laboratories, Sewage districts, Zoning, *District of Columbia.

The directory of water related organizations in the District of Columbia provides a listing of organizations working with or related to the field of water resources. The organizations listed include: the federal goverment, the District of Columbia, regional agencies, research and academic institutions, private firms, citizen committees and private interest organizations. For each organization the directory gives the name, the key people, the mission and objectives, the structure and the involvement and the interest in water and water related activities. Organizations in the body of the directory are listed by categories. The format of the Table of Contents should help to understand some of the hierarchical interrelationships among organizations. The Glossary of Acronyms is intended to aid the identification of organizations and some of the special vocabulary used among water-related orga-

nizations. An alphabetical index will help in location of organizations within the directory.
W83-02295

DIRECTORY OF GROUNDWATER PROGRAMS AND ACTIVITIES OF THE FEDERAL GOVERNMENT.
Department of the Interior, Washington, DC. Office of Water Policy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182048, Price codes: A05 in paper copy, A01 in microfiche. Report issued by Office of Water Policy, U.S. Department of the Interior, February 1983. 79 p.

Descriptors: Groundwater, Aquifer, *Groundwater resources, *Aquifer management, Directories, *Groundwater directories, *Federal government, *Federal jurisdiction, Water policy, Federal project policy, Legal aspects, Information exchange.

This directory provides brief descriptions and contacts for additional information on each of 44 groundwater programs and recurring groundwater-related activities of the Federal Government. It was prepared in response to requests from the Interstate Conference on Water Problems and the National Governors' Association and with the assistance of the agencies identified herein. The directory contains a listing of those regulatory, technical assistance, research, funding and land management activities of the Federal Government that have as their primary purpose the monitoring, protection or conservation of groundwater quantity and quality. Agencies were asked to submit for the directory only those activities that have groundwater as a primary component, where the Federal government is the principal decisionmaking authority and which are longer than one year duration. Some Federal activities that impact on groundwater are left out intentionally. Enough detail is provided in the descriptive summary to allow a user to decide whether the activity is related to a particular problem. More information can then be obtained from the agency contact. An attempt has been made to identify persons who would be most familiar with local groundwater situations. List of regional and State contacts are provided for many activities. The legislative authority for each activity is cited in such a way that user can locate the information in university libraries and many of the larger municipal libraries.
W83-02361

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BIBLIOGRAPHY ON GROUND-WATER RECHARGE IN ARID AND SEMIARID AREAS,
Arizona Water Resources Research Center, Tucson.
S. J. Keith, P. Paylore, K. J. DeCook, and L. G. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-182055, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, AZ, July, 1982. 149 p. OWRT C-00155-T(1483)(1), 14-34-0001-1483.

Descriptors: Groundwater, *Groundwater recharge, *Arid climates, Groundwater quality, Isotopes, Stable isotopes, Radioisotopes, Tracers, Groundwater management, Landfills, Irrigation, Land use, Water quality, Mining, Models, Water pollution effects, Waste water, Safe yield, Nitrates, *Bibliographies, Ephemeral flow recharge, Mountain recharge, Sahara Desert, Basin and range province, Kalahau Desert.

This bibliography provides references on natural and man-caused recharge in arid and semiarid areas. The literature on natural recharge includes citations on stream channel recharge, mountain recharge, mountain-front recharge, and precipitation-infiltration recharge. The literature on man-caused recharge includes citations on recharge from activities such as irrigation, mining, and waste-water treatment and disposal, but does not include citations on artificial recharge. Most citations are abstracted; all are keyworded. The bibliography may be accessed through keyword and author indices.
W83-02362

10F. Preparation Of Reviews

RURAL DRINKING WATER TECHNOLOGY TRANSFER ASSESSMENT,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 5F.
W83-02318

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 16, NUMBER 8
AUGUST 1983

W83-02451 -- W83-02800
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 16, NUMBER 8
AUGUST 1983

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

OXYGEN-18 AND DEUTERIUM DETERMINATION ON A SINGLE WATER SAMPLE OF A FEW MILLIGRAMS,
Okayama Univ. (Japan). Inst. for Thermal Springs Research.
N. Kishima, and H. Sakai.
Analytical Chemistry, Vol 52, No 2, p 356-358, February, 1980. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Isotope studies, *Oxygen isotopes, *Deuterium, Water analysis, Hydrogen isotopes, Micro carbon dioxide-water equilibration technique.

A simple micro carbon dioxide-water equilibration technique was developed for the precise analysis of the O18/O16 ratio. The water sample and CO2 are frozen in a cavity in the equilibration vessel and allowed to equilibrate for a specified period. Upon warming, the carbon dioxide and the water condense into two separate rings. The carbon dioxide is liberated from the trap, and the water component is converted to hydrogen in a uranium furnace. Both CO2 and hydrogen samples are then subjected to isotopic analysis by mass spectrometry. The O isotope analysis was within + or - 0.1% of the given value in 13 of 16 runs; that of deuterium, within + or - 1% in 9 of 16 analyses. (Cassar-FRC)
W83-02651

1B. Aqueous Solutions and Suspensions

ENERGY ASPECTS OF EQUILIBRIUM CO-CRYSTALLIZATION FROM AQUEOUS SOLUTION,
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
For primary bibliographic entry see Field 2K.
W83-02585

THE HYDROPHOBIC INTERACTION IS LONG RANGE, DECAYING EXPONENTIALLY WITH DISTANCE,
Australian National Univ., Canberra. Dept. of Applied Mathematics.
J. Israelachvili, and R. Pashley.
Nature (London), Vol 300, No 5890, p 341-342, November, 1982. 2 Fig, 22 Ref.

Descriptors: *Mathematical studies, *Physical properties, *Solutions, Organic compounds, Water properties.

The forces between two hydrophobic surfaces in aqueous solutions were measured in the distance range D=O to D 50 nm. The experimental techniques used were similar to those used earlier to measure the forces between mica surfaces in liquids, which allow the force between two crossed cylinders of mica to be measured with a distance resolution of about 0.2 nm. It was noted that the hydrophobic interaction acts over the long range and cannot be considered as arising from any bond-like association. For two surfaces 50% of the total interaction free energy occurs at distances beyond about two water molecule diameters. The exponential dependence of the interaction has been predicted in recent theories of solvation forces. The long-range attractive forces measured between surfactant and lipid bilayers where both hydrophilic and hydrophobic groups are present at these interfaces appear to be well described by the van der Wals dispersion force, suggesting that the hydrophobic interaction is neutralized when the local structure of water molecules is dominated by their interaction with nearby hydrophilic groups. (Baker-FRC)
W83-02778

2. WATER CYCLE

2A. General

THE GENESIS OF A NUMERICAL MODEL FOR THE STUDY OF THE HYDROGEOLOGY OF A STEEP HILLSIDE IN HONG KONG,
Hong Kong Public Works Dept. Geotechnical Control Office.
B. Leach, and R. Herbert.
Quarterly Journal of Engineering Geology, Vol 15, No 3, p 243-259, 1982. 19 Fig, 1 Tab, 17 Ref.

Descriptors: *Slopes, *Model studies, Numerical models, *Hydrogeology, *Evapotranspiration, Soil water, Rainfall infiltration, Mathematical models, Hills, Hydrodynamics, Mathematical studies, *Hong Kong, Slope stability.

A finite, forward-difference numerical model was developed to aid in studying the hydrology of a steep hillside in Hong Kong. Model calculations were based on contours of the highest observed elevations of the main groundwater table during the 1979 and 1980 wet seasons. Since hydraulic gradients were steep and flow was rapid downslope, a two dimensional time variant representation was used. Calibration of the model against observed piezometric responses during the 1980 wet season has shown the importance of indirect recharge from bedrock in sustaining the system. The vital role of evapotranspiration in assessing direct recharge from rainfall to the system was also demonstrated. The model may be applied to the estimation of extreme water levels as input for slope stability analysis problems. An analysis of model discretization errors is presented. (Geiger-FRC)
W83-02474

ORDER SELECTION OF AR MODELS OF HYDROLOGIC TIME SERIES,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
G. Padmanabhan, and A. R. Rao.
Nordic Hydrology, Vol 13, No 2, p 93-104, 1982. 3 Fig, 1 Tab, 36 Ref.

Descriptors: *Hydrologic models, *Time series analysis, *Regression analysis, *Probabilistic process, *Model testing, Model studies, Mathematical studies, Mathematical models, Statistical methods, Decision making, *Autoregressive models.

The Akaike's Information Criterion (AIC) has been widely used for the determination of order of autoregressive (AR) models of hydrologic time series modeling, despite the fact that it is statistically inconsistent. Several other decision rules have been proposed for selecting orders of AR models, and several are analyzed by both hydrologic and nonhydrologic time series. One such rule, the Posterior Probability rule, is statistically consistent and possesses optimality. The Posterior Probability rule can also estimate the probability of selecting the correct model. Although the orders of AR models given by the various decision rules are not very different in many of the 12 time series analyzed, the Posterior Probability criterion is preferred due to its properties of optimality and asymptotic consistency. (Geiger-FRC)
W83-02476

REMOTE SENSING DETERMINATION OF HYDROGRAPH RECESSION CHARACTERISTICS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
G. A. Willett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186627, Price codes: A02 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, February 1983. 15 p, 1 Fig, 1 Tab, 35 Ref. OWRT A-086-IDA(1), 14-34-0001-2114.

Descriptors: *Remote sensing, Hydrology, Base flow, Photogrammetry, *Basin characteristics, Precipitation, Groundwater, Literature reviews, Minimum flow.

A review of literature indicates that little work is being done on determining base of minimum flows from basin characteristics using remote sensing techniques. The majority of the work being done on base flows is by the use of mathematical models using information that can be obtained from topographic maps. Remote sensing techniques have been used mainly for determining water quality, inventories, and determing hydrological characteristics that could be determined from topographic maps as well. The effects of vegetation cover, unique geological factors, moisture content of soil, and weather patterns are recognized but not utilized within the mathematical models. Information obtainable by the use of remote sensing should be useful for revising existing mathematical models to provide more accurate predictions of not only base or minimum flows but of average and peak flows.
W83-02487

THE EFFECTS OF SNOW COMPACTION ON WATER RELEASE AND SEDIMENT YIELD-BRIDGER BOWL SKI AREA, GALLATIN COUNTY, MONTANA,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W83-02491

DESIGN AND ANALYSIS OF URBAN STORM DRAINAGE - THE WALLINGFORD PROCEDURE,
Civil Engineering (London), p 41,43, March, 1982.

Descriptors: *Urban drainage, Model studies, *Rainfall-runoff relationships, *Storm runoff, *Storm drains, *Hydraulic design, *Computer models, Urban runoff, Urban hydrology, Simulation anlysis, Surface runoff, Wallingford procedure, Computers.

After five years of research, a working party at the Hydraulics Research Station produced a five volume report on the design and analysis of urban storm drainage called the Wallingford Procedure. The report covers four new methods of analysis along with computer programs for implementing the new procedures. The Wallingford modified rational method gives a value of peak discharge and may be used with or without a computer. The computer version includes the facility to represent storm overflows. The Wallingford Hydrograph method, a computer-based hydrograph method, incorporates separate models of the surface runoff and pipe-flow phases. The Wallingford Optimizing method, a computer-based method, incorporates the optimized design of pipe depth and gradient as well as diameter. The Wallingford Simulation method, also a computer-based method, monitors the performance of an existing system or proposed design when operating under surcharged conditions. The programs were tested at the Hydraulics Research Station for their applicability to typical urban drainage problems and their reliability and accuracy in simulating observed rainfall runoff events. Results showed that the Wallingford programs proved as accurate as or more accurate than existing models for simulating factors of urban runoff. However, since all the models had some limitations in predicting minute details of the rainfall-runoff process, considerable caution should be taken in using them for interpretation of single urban runoff events. (Geiger-FRC)
W83-02550

MODIFIED RUNOFF CURVE NUMBERS FOR SUGARCANE AND PINEAPPLE FIELDS IN HAWAII,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley, and L. J. Lane.
Journal of Soil and Water Conservation, Vol 37, No 5, p 295-298, September/October, 1982. 5 Tab, 9 Ref.

Descriptors: *Rainfall-runoff relationships, *Erosion control, *Farm management, Land management, Erosion, *Sugarcane, *Pineapple, Watersheds, Ground cover, *Hawaii.

Runoff curve numbers for sugarcane and pineapple fields in Hawaii were derived from rainfall and runoff data collected during a 7 year study between 1972 and 1979. The new curve number values were used to modify previously determined values based on 5 years of data and to adjust Soil Conservation handbook values. Handbook values were based mainly on experience obtained under mainland conditions and soils. The data-based curve numbers were slightly lower than previously used handbook values for sugarcane fields. The greatest differences were for porous A soils and complete cover conditions. The data based curve numbers were considerably lower than handbook values for pineapple fields, where field roads occupied 11 to 20% of the area. The greatest differences were noted after pineapple had reached the partial or complete cover stage, indicating that pineapple provides more protection than expected once it covers at least 50% of the field surface. Observations suggest that major portions of the runoff come from field roads, for which curve numbers are two to three times greater than those derived from the cropped area. (Baker-FRC)
W83-02706

THE EFFECT ON STORM RUNOFF RESPONSE OF SEASONAL VARIATIONS IN CONTRIBUTING ZONES IN SMALL WATERSHEDS,
Trent Univ., Peterborough (Ontario).
C. H. Taylor.
Nordic Hydrology, Vol 13, No 3, p 165-182, 1982. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Storm runoff, *Seasonal variations, *Watersheds, Runoff, Rainfall-runoff relationships, *Ontario, Canada, Wetlands, Snowmelt, Infiltration, Soil properties.

Storm runoff production by saturation overland flow has been studied in two small watersheds in south central Ontario. One watershed is classified in two small watersheds in south central Ontario. One watershed is classified as having rural land use and contains a wetland. Here the total saturated zone is at its maximum extent during spring snowmelt, when the overwhelming majority of total runoff and quickflow is produced. The stream seldom flows during the summer and winter seasons, but does so occasionally in the fall if the wetland is recharged sufficiently. Simple calculations show that the storm-to-storm variations in quickflow response are controlled by the extent of surface soil saturation (measured by field mapping and correlated with antecedent wetness variables) and precipitation amount. The other watershed has been undergoing suburban development since 1973. Quickflow response during summer and fall seasons has not appreciably changed since then, although 30% of the watershed surface has been disturbed. This is because in those seasons quickflow is still produced as saturation overland flow from the original contributing zones alongside the stream. In contrast, during spring snowmelt the very wet soil conditions and a high water table allow the disturbed surfaces with low infiltration capacities to be integrated into the contributing area via normally dry drainage lines. As a result spring quickflow has increased by three to four times over the original values. (Baker-FRC)
W83-02779

2B. Precipitation

LOS ANGELES RAINFALL FREQUENCIES CHANGE AS RECORD LENGTHENS,
California State Univ., Northridge.
A. Court, and W. Reid.
Monthly Weather Review, Vol 110, No 1, p 44-45, January, 1982. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Rainfall, *Frequency analysis, *Climatology, *Los Angeles, *Rainfall intensity, Precipitation, Mathematical studies, Regional analysis, Frequency distribution, Probability distribution, Hydrometeorology, *California.

Previous research by Showalter (1948) based upon tabulations of 70 years of wet and dry rainfall years at Los Angeles (1877-78 through 1947-48) showed the presence of three 33 or 34 year precipitation classes. In the first sequence, 6 wet, 5 normal, and 5 years were identified. Each of thes sequences was followed mostly by dissimilar sequences in the first 33 years. In the next 33 years, the trend was reversed, so that wet-wet, normal-normal, and dry-dry pairs occurred. The later 33-year period was a little drier than the first 70 years. Previous finding claimed that like-like successions were less frequent than might be expected at Sacramento, Louisville, Denver, and Salt Lake City, but more frequent at San Diego, Albany, St. Louis, Washington, D. C., and New York City. Examination of the last 33 years of a 103 period at Los Angeles shows that these findings may be doubtful. Showalter concedes his previously drawn conclusions to the present findings, which indicate a change in the rainfall frequencies of Los Angeles as the record is lengthened. (Geiger-FRC)
W83-02472

USE OF THE EXTREMAL-3 DISTRIBUTION IN PRECIPITATION EVALUATION AND LOW WATER ANALYSIS (DIE ANWENDUNG DER EXTREMAL-3-VERTEILUNG BEI DER REGENAUSWERTUNG UND DER NIEDRIGWASSERANALYSE),
Dorsch Consult G.m.b.H., Munich (Germany, F.R.).
W. Koniger.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 10, p 460-466, October, 1981. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Mathematical studies, *Distribution, *Precipitation, Rainfall, Precipitation distribution, Mathematical equations, Flow.

The basic relationships for the extreme-value type-3 distribution are reviewed. The shortcomings of fitting the distribution by the method of moments or regression are discussed. It is noted that up to now the application of the Maximum Likelihood method to the extreme-value type-3 distribution has been made using the wrong assumptions. Using the principle of maximum entropy, derived from the mathematical theory of information, it is shown that the two simple equations provide unbiased estimates of the paramters of extreme-value distributions. The inferences are illustrated by examples of annual series of low flow and partial duration series of precipitation data. (Baker-FRC)
W83-02590

GROUND-WATER RECHARGE RATES IN MINNESOTA AS RELATED TO PRECIPITATION,
Minnesota Geological Survey, St. Paul.
For primary bibliographic entry see Field 2F.
W83-02730

ACIDIFICATION OF GROUNDWATER IN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2K.
W83-02793

DETECTION OF RAINFALL RATES UTILIZING SPACEBORNE MICROWAVE RADIOMETERS,
Environmental Research and Technology, Inc., Concord, MA.
H-H. K. Burke, K. R. Hardy, and N. K. Tripp.
Remote Sensing of Environment, Vol 12, No 2, p 169-180, 1982. 8 Fig, 3 Tab, 11 Ref.

Descriptors: *Rainfall rate, *Measuring instruments, *Radiometry, Microwave radiometers, Mie theory, Rainfall, Remote sensing.

Raindrops both absorb and scatter radiation over most of the microwave spectrum, producing large changes in brightness temperatures relative to clear or cloudy conditions. Since the structure of rain varies substantially for different rain rates and climatological backgrounds, the raindrop size distribution, the rain layer thickness and the ice clouds above the rain layer are all important inputs to the model computations. The subsequent modeling involves applying the Mie theory to derive the absorption and scattering effects and the radiative transfer computations to derive the brightness temperature. Over ocean background lower frequencies are sufficiently sensitive to rain conditions. Over land background, higher frequencies are needed to obtain the sensitivity to rain rates. By using discrimination tests of the radiometric data, the rain/no rain decision can be made and the rainfall rate can be retrieved from a statistical inversion technique. The shortcomings of this technique are: the assumption of a homogeneous field of view at different wavelengths can be erroneous, the actual physical structure of the rain layer may be significantly different from the one used in the climatological approach, and additional uncertainty may be introduced because of the limitations of the radiative transfer algorithm. (Baker-FRC)
W83-02798

2C. Snow, Ice, and Frost

IDENTIFICATION OF SNOWCOVER DEPLETION PATTERNS USING SATELLITE IMAGERY,
Idaho Univ., Moscow. Dept. of Engineering Science.
L. F. Heitz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186122, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, February 1983. 30 p, 3 Fig, 5 Tab, 14 Ref. OWRT A-082-IDA(1), 14-34-0001-2114.

Descriptors: *Remote sensing, Satellites, *Snow cover, Snowmelt, Ablation, Streamflow forecasting, Runoff forecasting, *Idaho, Boise Basin.

The purpose of this research was to investigate whether there is a possibility of using satellite imagery to finely calibrate large scale basin runoff models. It is anticipated that by better understanding the snowcover depletion patterns in a basin the runoff models might be adjusted to better forecast both quantity and timing of runoff especially in the late stages of the snowmelt season. This forecasting of runoff is essential to the optimal operation of large multi-purpose, multi-reservoir water control systems. While no actual field or laboratory research was carried out, as a result of this project, a detailed literature review was made and contacts were made with many agency officials. The literature review, agency contacts and various parts of this report will serve as springboards in efforts to secure future funding in this research area. It appears that the Boise River Basin in Idaho would be the most likely candidate on which to develop the snowcover depletion pattern methodologies. The basin is well monitored as far as stream flows, it has a detailed hydrometerological instrumentation system and a detailed runoff model (Streamflow Synthesis and Reservoir Regulation Model, SSARR) is already operational for the basin. This report contains both project plans and budgets for complete studies of the snowcover depletion phenomena on the Boise Basin.
W83-02488

THE EFFECTS OF SNOW COMPACTION ON WATER RELEASE AND SEDIMENT YIELD-BRIDGER BOWL SKI AREA, GALLATIN COUNTY, MONTANA,
Montana State Univ., Bozeman. Dept. of Earth Sciences.
T. R. Grady, S. G. Custer, and J. Montagne.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186445, Price codes: A02 in paper copy, A01 in microfiche. Montana Water Resources Research Center Report No 124, Bozeman, June 1982. 23 p, 3 Fig, 3 Tab, 5 Ref. OWRT A-126-MONT(1), 14-34-0001-0128.

Descriptors: *Snow management, *Water yield, *Surface runoff, *Sediment yield, Density, Snow storage, Snow skiing, Albedo, Avalanches, Snow hydrology, Meltwater, *Montana, Bridger Bowl.

Little is known regarding the impact of ski compaction on runoff and sediment yield in downhill ski areas. This study uses a paired watershed approach to analyze the impact of snow compaction on runoff timing, hydrograph-peak height, and sediment yield. The two basins compared are adjacent to one another and have similar basin area, geology, relief, elevation, slope, and tree cover. The compacted watershed is adjacent to Bridgewater Bowl, is unskilled, and contains no roads. Results show that compacted snow releases water to streams 7-14 days later than uncompacted snow. The basin with snow compaction had a flashier hydrograph characterized by a steeper rising limb and a higher peak discharge than the uncompacted basin. Slope runoff collectors showed similar results. The delay of snow melt from the compacted snow which reduces the rate of heat transfer by water movement, impedes the development of wet snow grains, and so delays the release of water. For the basins compared in this study, snow compaction had little effect on sediment yield.
W83-02491

EXPERIENCE IN PREDICTING ELEMENTS OF THE ICE AND THERMAL REGIME OF THE LOWER POOLS OF HYDROELECTRIC STATIONS,
S. N. Nazarenko, T. E. Kozhevnikova, and L. I. Sulimova.
Hydrotechnical Construction, No 9, p 945-949, September, 1980. 3 Fig, 1 Tab, 5 Ref. Translanted from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 40-43, September, 1980.

Descriptors: *Ice formation, *Water temperature, *Reservoirs, Ice cover, Ice jams, Ice thickness, Temperature, Freezing, Hydroelectric plants, Flow velocity, Regulated flow, Environmental effects.

The ice regime in the lower pool of a hydroelectric plant depends on the temperature of the water, the magnitude of the discharge, meteorological conditions and flow characteristics. The winter coefficient (Kw) expresses the discharge capacity of the channel under the ice cover. In normal operation of large hydrostations the winter water temperature of the lower pool is close to the cross-sectional average temperature of the upper pool, despite considerable vertical stratification, The length of the polynya, or ice-free stretch below the dam, varied from 7 to 65 km in a survey of several hydrostations. Ice on the channel shores accumulates to about 25% of the total channel width in the polynya. The initial thickness of the ice cover is numerically equal to the flow velocity with flow velocities of 1 m per sec or greater and to half the velocity at velocities < 0.5-0.7 m per sec. Graphs of winter coefficients plotted against time for conditions of natural freezing in undammed rivers reveal three patterns.
W83-02621

WAVES ON GLACIERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
A. C. Fowler.
Journal of Fluid Mechanics, Vol 120, p 283-321, July, 1982. 5 Fig, 79 Ref.

Descriptors: *Waves, *Glaciers, *Glacier surges, Surges, Glaciology, Geophysics, Fluid mechanics, Hydrodynamics, Mathematical equations.

A mathematical synopsis of the theory of wave motions on glaciers is presented. These include surface waves and seasonal waves. The present thesis is that the two wave motions can both be derived from a rational theory based on conservation laws of mass and momentum, provided that the basal kinematic boundary condition involving boundary slip is taken to have a certain reasonable form. It is suggested that the form of this 'sliding law' is the crux of the difference between seasonal and surface waves, and that a further understanding of these motions must be based on a more satisfactory analysis of basal sliding. Ice is treated here in the context of a slow, shallow, non-Newtonian fluid flow, and therefore the theory that emerges is that of non-Newtonian viscous shallow-water theory; rather than balance inertia terms with gravity in the momentum equation, the shear-stress gradient is balanced. The resultant equations are a first-order nonlinear hyperbolic wave equation, susceptible to various kinds of analysis. It is demonstrated how both surface and seasonal waves are naturally described by such a model when the basal boundary condition is appropriately specified. Shocks can naturally occur, and the small diffusive parameters that are present are identified, and the shock structure given. This presents a useful understanding of the effects of surface slope and longitudinal stress in these waves. (Baker-FRC)
W83-02699

MEASUREMENT AND MODELING OF MICROWAVE EMISSION FROM FORESTED SNOWFIELDS IN MICHIGAN,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. K. Hall, J. L. Foster, and A. T. C. Chang.
Nordic Hydrology, Vol 13, No 3, p 129-138, 1982. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Model studies, *Measuring instruments, *Snow depth, Snow cover, Snowpack, Snow mantle, Snow density, Satellite technology, Forests, Soil moisture, Remote sensing, Data collections, *Michigan.

The microwave emissivity of snowcovered forests was analyzed, and subsequently a Nimbus-7 SMMR (Scattering multichannel microwave radiometer) data collection was used in a microscopic scattering model to substract the effects of the forest cover from the microwave brightness temperature (TB)/snow depth relationship in the lower peninsula of Michigan. Forest cover confused the normally inverse relationship between TB and snow depth in dry snowpacks. However, even in the presence of forest cover the average 37 GHz vertically and horizontally polarized TBs from Nimbus-7 were 11 and 19 degrees K lower during the study period in February of 1979 versus February of 1980. This is attributed to deeper average snowcover for the 1979 study period. The brightness temperature was correlated with snow depth for the study periods in 1979 and 1980, resulting in positive relationships instead of the expected inverse relationships. It is assumed that the emissivity of the forest cover overwhelmed that of the snow in both years, causing higher TBs in more heavily forested areas. A simple model was used to remove the effects of the trees from the relationship. A new value, residual brightness temperature, TBR, derived from the 37 GHz data, was correlated with snow depth for selected time periods in February resulting in inverse relationships. SMMR data of August 1979 were correlated with percent forest cover to determine the TB of the study area in the absence of snow. The lower SMMR frequencies showed statistically significant inverse relations with forest cover during the August study period. These were due to increased soil moisture in the more heavily forested areas in the northern half of the lower peninsula of Michigan, thus causing lower TBs. (Baker-FRC)
W83-02774

AREAL DIFFERENTIATION OF LAND AND LAKE SNOWCOVER IN A SMALL SUB-ARCTIC DRAINAGE BASIN,
Trent Univ., Peterborough (Ontario).
W. P. Adams, and N. T. Roulet.
Nordic Hydrology, Vol 13, No 3, p 139-156, 1982. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Snowcover, *Drainage basins, *Polar regions, Canada, *Labrador, Elizabeth Lake, Spatial distribution, Distribution, Hydrology, Lake ice.

A large, stratified, random sample was used to identify vegetation related patterns of snowcover and patterns of land and lake snowcover properties in the basin of Elizabeth Lake, Labrador, Canada. Spatial patterns of snow depth, density and water equivalent are discussed using analyses of variance and trend surface analyses. Statistically significant relationships are demonstrated between these properties and four distinctive landscape units, Tundra, Open Lichen Woodland, Close Lichen Woodland and Lake. The mid-winter lake snowcover displays special features. The low mean water equivalent of lake snowcover reflects both marked deflation and slushing. The hypothesis that wind removal from the landscape unit, as distinct from redistribution within the unit, is a marked feature of the Lake environment could only be confirmed with information on the density of snow incorporated into lake ice. The Lake snowcover exhibited quite marked spatial trends, e.g., in the snow depth pattern, at the time of the survey. The spatial trends of white ice (frozen slush) are readily predictable. It was clear that factors other than vegetation control snowcover in the basin, including topography, altitude, aspect and non-vegetative surface roughness. The trend surface analyses hinted at some of these effects, including upwind-downwind patterns in the basin, but marked broad scale wind effects were only present on the lake. The survey system used appears to be useful for hydrologic work. (Baker-FRC)
W83-02775

2D. Evaporation and Transpiration

SURFACE TEMPERATURE MODEL FOR EVAPORATION PANS (MODELISATION DE LA TEMPERATURE DE SURFACE DES BACS EVAPOROMETRIQUES),
Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).Lab. d'Hyraulique.
P. Dehon.
Journal of Hydrology, Vol 49, No 3/4, p 369-384, February, 1981. 14 Fig, 9 Ref.

Descriptors: *Evaporation pans, *Water temperature, *Mathematical models, *Pan evaporation, Evaporation, Evaporation rate, Air temperature, Wind velocity, Atmospheric pressure, Solar radiation.

A simple method is presented to estimate the surface temperature of evaporation pans. The model requires the measurement of the following climatological variables: the shortwave radiation of the sun, the air temperature, the actual vapor pressure, the relative sun light, and wind speed. The method is valid for shallow and deep (depth between 0.20 m and 2.0 m). The model also describes the daily development of surface temperature in terms of the energy balance. (Author's abstract)
W83-02673

A PRELIMINARY QUANTIFICATION OF THE IMPACTS OF ASPEN TO CONIFER SUCCESSION ON WATER YIELD WITHIN THE COLORADO RIVER BASIN (A PROCESS AGGRAVATING THE SALT POLLUTION PROBLEM),
Utah State Univ., Logan. Coll. of Natural Resources.
G. F. Gifford, W. Humphries, and R. A. Jaynes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191916, Price codes: A04 in paper copy, A01 in microfiche. Utah Water Research Laboratory Hydraulics and Hydrology Series UWRL/H-83/01, Utah State Univ., Logan, January 1983. 67 p, 24 Fig, 8 Tab, 63 Ref. OWRT B-175-UTAH(1), 14-34-0001-9138.

Descriptors: *Evapotranspiration, Forest hydrology, Forest management, Succession, *Conifers, Spruce, Fir, *Aspen, Transpiration, Vegetation effects, *Colorado River Basin, *Water yield, *Water yield improvement, *Utah, Chicken Creek watershed, Water budget, Plant succession.

Quaking aspen cover 3.3 million hectares in the Upper Colorado River Basin, and these areas are gradually converting to conifer forest by the natural process of ecological succession. This change is being hastened by forest managment practices that reduce fires, destroy pests, or otherwise prevent the natural processes that previously caused conifer areas to revert to the subclimax aspen. The hydrologic consequence has been forecast to cause a runoff reduction in the Colorado River as large

as one million acre-feet annually, a major blow to water availability in the Lower Basin. Understanding and dealing with the problems requires quantitative comparision of the evaportranspiration rates of conifer and aspen forests under a variety of conditions. For this comparison, heat pulse velocity techniques were developed for monitoring water movement in aspen (Populus tremuloides), subalpine fir (Abies lasiocarpa), an Englemann spruce (Picea engelmannii). Once the techniques were perfected, transpiration was monitored in trees of each species for one year. The data were used to estimate crop coefficients by time of year for each species within the model ASPCON, a deterministic, lumped-parameter model describing the hydrology of aspen to conifer succession. The results for one location indicate a 7.3 in. net loss in streamflow when spruce replace aspen, and net loss of 2.8 in. when fir forests cover a watershed. Aspen began using significant amounts of water a month or two later in the spring and thus are associated with much higher spring runoff. While details vary greatly with location, the aspen to conifer successional trend is significantly reducing water yields within the Colorado River Basin.
W83-02737

WEEKLY WATER USE ESTIMATES BY CROPS AND NATURAL VEGETATION IN INDIANA,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
J. E. Newman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191924, Price codes: A03 in paper copy, A01 in microfiche. Station Bulletin No 344, November 1981. 25 p, 1 Fig, 21 Tab, 3 Ref. OWRT A-999-IND(7).

Descriptors: *Evapotranspiration, *Crop water use, *Temperature, *Water use, Consumptive use, *Indiana, Climatogical areas, Data collections, *Thornthwaite method.

The Thronthwaite Method is used for estimating the weekly evapotranspiration for nine climatological divisions and crop reporting districts in Indiana. The estimates are based on possible mean weekly temperature values with proper weekly day length corrections during the growing season. The data begins with the climatogical week of March 1 to 7 and continues through 40 weeks of early December. There are 21 tables. Table 1 is based on 30 year average weekly temperatures for all 9 climatogical divisions. Tables 2 through 11 are based on 1 to 10 F above average weekly temperature deviations. Tables 12 to 21 are based on 1 to 10 F below average weekly temperature deviations. These 21 data tables contain approximately 99% of all possible weekly mean air temperatures and resulting ET value estimates that are likely to occur under Indiana climatic conditions.
W83-02739

2E. Streamflow and Runoff

PREDICTION OF EFFECTS OF DAILY FLOW FLUCTUATIONS ON STREAM BIOTA,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 6G.
W83-02480

IDENTIFICATION OF SNOWCOVER DEPLETION PATTERNS USING SATELLITE IMAGERY,
Idaho Univ., Moscow. Dept. of Engineering Science.
For primary bibliographic entry see Field 2C.
W83-02488

IMPROVEMENT OF THE ACCURACY OF PREDICTION OF STOCHASTIC MODELS OF THE OXYGEN CONCENTRATION IN RUNNING WATERS (VERBESSRUNG DER VORHERSAGEGENAUIGKEIT STOCHASTISCHER MODELLE DES SAUERSTOFFGEHALTES VON FLIESSGEWASSERN),
Technische Univ., Dresden (German D.R.).
W. Winkler, J. Beyer, and A. Gnauck.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 107-110, 1980. 1 Fig, 2 Tab, 4 Ref. (No English Summary).

Descriptors: *Model studies, Running waters, *Oxygen balance, Mathematical models, *Differential equations, *German Democratic Republic, Zwickauer Mulde river, Prediction, Simulation analysis, Forecasting.

A stochastic dynamic model formulated as a differential equation is presented for use in predicting the oxygen content of running waters. Water temperature, flow, and COD are the initial data used. With this equation, the instantaneous oxygen content is dependent on the previous events in the balancing process. At the start of the prediction, eight measured values are inserted into the equation. At a later time, two estimated oxygen values are inserted. If estimated values are replaced by measured oxygen values at certain points in time (e.g., when predetermined tolerance thresholds are exceeded or undercut), the model, which was inaccurate up to this point due to stochastic interferences, is corrected or updated. The intervals between such corrections vary during a simulation calculation and are dependent on the accuracy of the model at time t as well as on the formulation of the model itself. The model was tested for the Zwickauer Mulde river (German Democratic Republic) with oxygen values measured at 2-, 4-, 8-, and 24-hr intervals. Good predictions were achieved when actual values were inserted whenever the divergence from the tolerance level was + or - 1 mg O2/l, even with long observation intervals, although the number of corrections necessary increased with increasing observation intervals. When measurements were taken at 24-hr intervals, the model was 97.8% accurate, though the number of required corrections (120) was greater than when measurements were taken at 2-hr intervals (95.9% accuracy, 74 corrections). (Gish-FRC)
W83-02658

COMPUTATION OF FLOW PATTERNS IN RIVERS,
Waterloopkundig Lab., Delft (Netherlands).
C. B. Vreugdenhil, and J. H. A. Wijbenga.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1296-1310, November, 1982. 15 Fig, 1 Tab, 19 Ref.

Descriptors: *Flow patterns, *Rivers, *Hydrodynamics, Fluid mechanics, Streamflow, Viscosity, Slope, Flood plains, Mathematical equations.

A computational method for the steady or quasisteady flow in a river with flood plains has been presented. The numerical technique has been adapted from unsteady flow models, but a different behavior is obtained due to the balance of terms in the hydrodynamic equations. The following conclusions were drawn. Lateral diffusion of momentum (viscosity) has an appreciable effect on the velocity distribution, and consequently on the total resistance or the surface slope. If sufficiently accurate values of bottom-roughness and viscosity are available, good agreement between measured and computed flow patterns and water levels may be obtained. Relatively little is known about the viscosity under various field conditions; moreover, an accurate determination of bottom roughness under field conditions is difficult. Therefore, it is important to have field measurements of velocities and water levels for calibration of both parameters. (Baker-FRC)
W83-02692

FLOW COMPUTATION USING EXTRAPOLATION PROCEDURES,
Geological Survey, Reston, VA.
C. Lai.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1374-1380, November, 1982. 1 Tab, 10 Ref.

Descriptors: *Hydraulics, *Mathematical equations, *Extrapolation, Mathematical studies, Unsteady flow, Flow, Rivers, Sacramento River, Streamflow, *California.

The advantages of applying extrapolation procedures are explored through a review and examination of the method, demonstration by numerical experiments, and some analysis of related matters. The extrapolation procedure conveniently assumes that the computational error is a polynomial function of a grid interval. This makes it possible to eliminate one or more terms of lower powers of the grid interval through a linear combination operated on a set of numerical solutions using different sizes of the grid interval. Thus the order of error can be theoretically raised higher than that of the original set. Numerical experiments can be used with advantage to that of the original set. Numerical experiments can be used with advantage to test the applicability and the effectiveness of the extrapolation procedure. The specific numerical experiments conducted herein for a Sacramento River reach, together with the previous investigations and experiments in the area, indicate that the technique is a remarkably powerful and economical tool in attaining a second order result from simple linear computations. It is believed that the procedure can be sidely and effectively applied in computational hydraulics. (Baker-FRC)
W83-02695

MUSKINGUM-LIKE APPROXIMATIONS FOR WATER ROUTING,
General Electric Co., Philadelphia, PA. Space Systems Div.
W. C. Peterson, and F. H. Verhoff.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1387-1393, November, 1982. 6 Ref.

Descriptors: *Model studies, *Hydrographs, *Flood control, *Muskingum methods, Flood routing, Mass.

Mathematical approximations of the conservation of mass for water in a river are used to generate formula related to the Muskingum model. For certain choices of the parameters, this model reduces to the classical Muskingum method and suggests that other choices of parameters will make the predictions of the downstream hydrograph totally dependent on the upstream information. Further, the order of approximation involved in the Muskingum method is analyzed and related to prior work. (Baker-FRC)
W83-02696

QUANTIFYING SOURCE AREAS THROUGH LAND SURFACE CURVATURE AND SHAPE,
Massey Univ., Palmerston North (New Zealand). Dept. of Geography.
R. G. Heerdegen, and M. A. Beran.
Journal of Hydrology, Vol 57, No 3/4, p 359-373, June, 1982. 3 Fig, 1 Tab, 26 Ref.

Descriptors: *Maps, *Water supply, Water resources development, Hydrodynamics, Floods, Runoff, Surface flow, Slope, Hydrologic maps, Flood forecasting, *England, *Wales, Land surface curvature.

A technique is described for map analysis in identifying hydrologically active localities said to be responsible for quick-response flood runoff. These areas are recognized as areas with convergent flow paths and retarding overland slope. Measures of curvature and slope are constructed and used in a pilot-scale regression analysis with flood response quantities as dependent variables. No large improvement in predictive ability over conventional catchment characteristics was found, although the relative importance of the variables, the derived curvature maps and the techniques employed will be of interest to modellers. (Baker-FRC)
W83-02702

NUMERICAL ANALYSIS OF THE TETON DAM FAILURE FLOOD,
Columbia Univ., New York.
A. Balloffet, and M. L. Scheffler.
Journal of Hydraulic Research, Vol 20, No 4, p 317-328, 1982. 5 Fig, 20 Ref.

Descriptors: *Floods, *Model studies, *Failure analysis, Dams, *Teton Dam, Mathematical equations, Channels, Flood hydrographs, Reservoirs, *Dam failure, *Idaho.

The Teton Dam failure flood is modeled with an explicit scheme in a network of channels and reservoirs, taking into consideration the progressive inundation and drying of the flood plain. Previous studies on the same flood have been made using one-dimensional models, producing averaged stage and discharge hydrographs across the flood plain. Results of the models were compared with data from field surveys made after the flood. It was found that the network analysis allowed for more accurate representation of flood propagation in a complex topography. (Baker-FRC)
W83-02703

SALTCEDAR INFLUENCE ON SEDIMENTATION IN THE BRAZOS RIVER,
Texas A and M Univ., College Station. Dept. of Range Science.
For primary bibliographic entry see Field 2J.
W83-02704

2F. Groundwater

FIELD EVIDENCE FOR SHALE MEMBRANE FILTRATION OF GROUNDWATER, SOUTH-CENTRAL MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Geology.
D. T. Long, and G. J. Larson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190488, Price codes: A04 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, Michigan State Univ., East Lansing, March 1983. 51 p, 6 Fig, 6 Tab, 45 Ref, 1 Append. OWRT A-108-MICH(1), 14-34-0001-1124.

Descriptors: *Aquifer, *Groundwater, *Geochemistry, *Bedrock, *Tritium analysis, *Michigan, Saginaw formation aquifer, Recharge, *Shale membrane filtration, Ions, Rock types.

Shale membrane filtration is the process that controls the groundwater geochemistry of part of the Saginaw Formation aquifer in south-central Michigan. This process purports that certain rock types such as shales act as semi-permeable membranes which can selectively retard the movement of dissolved ions in a water migrating through the membrane. Based on the recharge information and surficial bedrock lithology, two study areas were chosen in south-central Michigan to test the occurrence of shale membrane filtration in the Saginaw Formation. Tritium analysis of selected wells, in one area, supports the presence of local 'point recharge' through sands and gravels to sandstone at the surface of the Saginaw Formation. The other area, based on tritium analysis, does not show the presence of local point recharge. Ion ratios from bedrock waters in the two study areas were found to increase or decrease relative to each other as would be predicted by shale membrane filtration theory, laboratory experiments, and field studies. Water-rock interactions and mixing with other chemically different waters do not correctly explain the observed ion rations, or cannot explain all the ratios as does shale membrane filtration. Shale membrane filtration best explains the observed geochemistry of Saginaw Formations's waters from the study area where conditions are favorable for the occurence of membrane filtration.
W83-02483

SYMPOSIUM ON SURFACE COAL MINING AND RECLAMATION IN THE NORTHERN GREAT PLAINS, AN UPDATE ON MINE SPOILS HYDROLOGY SOUTHEASTERN MONTANA,
Montana Bureau of Mines and Geology, Butte.
W. A. Van Voast.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186486, Price codes: A02 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 125, Montana State Univ. Bozeman, April 1981. 17 p, 6 Fig, 1 Tab, 3 Ref. OWRT A-113-MONT(1), 14-34-0001-9028 14-34-0001-0128.

Descriptors: *Groundwater, *Coal mining, *Strip mines, *Aquifer characteristics, Hydrologic systems, Spoil banks, Backfill, Hydraulic conductivity, Water quality, *Montana, Fort Union formation, McKay bed, Spoils hyrdrology.

Coal beds serving as important aquifers for southeastern Montana's agriculture are being removed through strip mining and replaced by rock materials (spoils). As mine pits are backfilled, water reenters the spoils establishing saturated thickness up to 40 feet where recharge from surface impoundments occurs. Hydraulic conductivities of mine spoils are similar to those of replaced coal beds. Water quality in backfilled spoils is highly diverse. Dissolved solids contents in spoils water at the Rosebud, Big Sky, and Decker mines are 64, 100, and 39% higher, respectively, than concentrations in nearby stock and domestic supplies.
W83-02495

HYDROCHEMICAL EVOLUTION OF THE EAST MIDLANDS TRIASSIC SANDSTONE AQUIFER, ENGLAND,
Institute of Geological Sciences, London (England). Hydrogeology Unit.
For primary bibliographic entry see Field 2K.
W83-02616

HYDRODYNAMIC CONDITIONS FOR COMPUTER SIMULATION OF PHYSICOCHEMICAL INTERACTIONS IN A WATER-ROCK SYSTEM IN HYDROGEOCHEMICAL FORECASTING: APPLICATION TO CAF2 WITH SOLUTIONS OF VARIOUS COMPOSITIONS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2K.
W83-02617

APPLICATION OF THE AQUIFER'S AVERAGE CHARACTERISTICS FOR DETERMINING THE ONSET OF THERMOHALINE CONVECTION IN A HETEROGENEOUS AQUIFER,
Florida Univ., Gainesville. Dept. of Civil Engineering.
H. Rubin.
Journal of Hydrology, Vol 57, No 3/4, p 321-336, June, 1982. 8 Fig, 5 Ref.

Descriptors: *Aquifer characteristics, Flow, *Thermohaline convection, Convection, Mathematical equations, Model studies, Simulation, Hydraulic resistivity, Heat diffusivity, Solute dispersion tensor.

Suggestions are offered as to how to calculate the value of an aquifer's average hydraulic resistivity, heat diffusivity, and solute dispersion tensor. All of these are represented by second-order tensors, provided that local characteristics of the aquifer vary with depth. Calculations of diffusive thermohaline convection show that the approximate method of the aquifer's average characteristics can be useful for predicting the flow field stability. The method does not supply a complete picture of all changes in the structure of the convection cell due to the aquifer heterogeneity, but values of critical and overstable Rayleigh number obtained by this method are almost identical to those obtained by accurate methods. The method of the aquifer's average characteristics was applied in this study for predicting the onset of dispersive thermohaline convection. Such a phenomenon occurs in an aquifer originally subject to hydraulic gradients, leading to horizontal flow of the groundwater. The analysis showed how variations of the principal components of the average characteristic tensors affect thhe criteria of marginal stability and overstability of the flow field. (Baker-FRC)
W83-02674

THERMOHALINE CONVECTION IN A NONHOMOGENEOUS AQUIFER,
Florida Univ., Gainesville. Dept. of Civil Engineering.
H. Rubin.
Journal of Hydrology, Vol 57, No 3/4, p 307-320, June, 1982. 3 Fig, 3 Ref.

Descriptors: *Aquifer characteristics, *Convection, *Temperature gradients, *Thermohaline convection, Aquifers, Groundwater supplies, Geothermal studies, Salinity, Hydrodynamics, *Linear stability analyis.

Linear stability analysis of the onset of thermohaline convection in a nonhomogeneous aquifer is developed. In this analysis variations of the hydraulic resistivity and heat diffusivity of the porous medium are employed. It is assumed that the parameters vary along the vertical direction. The equations which simulate the point of instability are nonlinear. Utilizing the Galerkin method when applying Fourier series expansions expressing the flow field perturbations, a set of linear homogeneous equations is obtained which yield two different secular equations related to marginal stability and overstability, respectively. It is suggested that the aquifer's properties be expressed by Fourier series expansions, mainly if these properties' profiles have points of discontinuity. Subroutines available in computer libraries can be used for the computations. The analysis shows that the point of instability is related to marginal stability or overstability. Simulations concerning nonlinear stability analysis may reveal how overstable motions enhance the intensity of convection currents in the aquifer. Such simulations can also be helpful for the interpretation of field measurements of piezometric head, temperature and salinity profiles in an aquifer subject to thermohaline convection. The nonhomogeneity of the aquifer modifies the symmetrical shape of the covection cell. Larger flow velocities as well as temperature and salinity gradients exist in the less resistant regions of the saturated porous formation. (Baker-FRC)
W83-02675

WELL HYDRAULICS IN VERTICALLY HETEROGENEOUS FORMATIONS,
Exxon Production Research Co., Houston, TX.
T. D. Streltsova.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1311-1327, November, 1982. 11 Fig, 43 Ref.

Descriptors: *Hydraulics, *Wells, *Aquifer characteristics, Drawdown, Groundwater, Aquifers, Permeability, Infiltration, Water storage.

Comparative analysis of time-dependent drawdown alterations caused by the heterogeneous properties of stratified formations is given based on the solutions developed under different assumptions on interlayered crossflow. The assumption of proportionality of leakage to the differential flow depletion, which is widely used in leaky aquifers developments, severely modifies the calculated drawdown values for both the aquifer and the aquitard as compared to those values obtained by assuming the diffusivity distribution process for the flow within each layer. The drawdown pattern is particularly affected at the early times. It is shown that if the compressibility of the low permeability layer is taken into account, the shape of transient drawdown curves is a function not only of the ration of permeabilities of the permeable and the semipermeable layers but of the ratio of their storages as well. (Author's abstract)
W83-02693

VALLES CALDERA GEOTHERMAL SYSTEMS, NEW MEXICO, U.S.A.,
Los Alamos Scientific Lab., NM.
F. Goff, and C. O. Grigsby.
Journal of Hydrology, Vol 56, No 1/2, p 119-136, March, 1982. 6 Fig, 3 Tab, 38 Ref.

Descriptors: *Geothermal resources, *Exploration, *Energy sources, *Geohydrology, Valles Caldera, *New Mexico, Volcanoes, Drilling, Hot dry rock systems, Thermal water, Saline water, Deep wells, Wells, Powerplants, Electric powerplants, Hydrothermal studies.

Valles Caldera is part of a Quaternary silicic volcano in northern New Mexico that posesses enormous geothermal potential. The caldera has formed at the intersection of the volcanically active Jemez lineament and the tectonically active Rio Grande rift. Volcanic rocks of the Jemez Mountains overlie Paleozoic-Mesozoic sediments and Precambrian granitic basement. Although the regional heat flow along the Rio Grande rift is about 2.7 HFU (1 heat flow unit = 1 microcal/sec/sq cm), convective heat flow within the caldera exceeds 10 HFU. A moderately saline hot-water geothermal system (T greater than 260 deg C, Cl = 3000 mg/liter) has been tapped in fractured caldera-fill ignimbrites at depths of 1800 m. Surface geothermal phenomena include central fumaroles and hot acid springs surrounded by dilute thermal meteoric hot springs. Derivative hot springs from the deep geothermal reservoir issue along the Jemez fault zone 10 km southwest of the caldera. Present geothermal projects are: (1) proposed construction of an initial 50-MW power plant using known geothermal reservoirs, (2) research and development of the prototype hot dry rock geothermal system that circulates surface water through deep Precambrian basement (about 5 MW); (3) exploration for deep hot fluids in adjacent basin-filled sediments of the Rio Grande rift; and (4) shallow exploration drilling for hot fluids along the Jemez fault zone. (Author's abstract)
W83-02701

GROUND-WATER RECHARGE RATES IN MINNESOTA AS RELATED TO PRECIPITATION,
Minnesota Geological Survey, St. Paul.
R. Kanivetsky, and B. Palen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191858, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Completion Report, Univ. of Minnesota, St. Paul, March 1983. 37 p, 43 Ref. OWRT B-153-Minn(1), 14-34-0001-0268.

Descriptors: *Evaporation, *Groundwater recharge, Hydrogeology, Recharge, Permeability, Precipitation, *Storage coefficient, Stream discharge, *Minnesota, *Groundwater level fluctuations.

Quantitative estimates of recharge rates and storage coefficients in sufficient detail are essential to any meaningful state water-resources management, policies, plans and legislation. A methodology was developed to derive quantitative estimates of ground-water recharge rates and storage coefficients for unconfined aquifers in the various hydrologic regions of Minnesota. Recharge estimates are based on information from ground-water hydrographs. Statistical analysis of ground-water level fluctuations and their correlation with precipitation, evaporation, stream discharge were evaluated. Harmonic analysis and autoregression analysis of water levels were done. Storage coefficients were estimated from pumping test data, soil moisture method and empirical equations. Groundwater recharge rates were determined by combining data on ground-water level fluctuations and storage coefficient evaluation for unconfined aquifers in Minnesota. This work is fundamental to the ultimate goal of an interactive water resources model of the state.
W83-02730

2G. Water In Soils

RHIZOS: A SIMULATION OF ROOT GROWTH AND SOIL PROCESSES. SENSITIVITY ANALYSIS AND VALIDATION FOR COTTON,
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
B. Bar-Yosef, J. R. Lambert, and D. N. Baker.
Transactions of the ASAE, Vol 25, No 5, p 1268-1273, 1281, September/October, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Plant growth, *Computers, *Soil moisture, Water availability, Nutrients, Model studies, Uptake, Soil-water-plant relationships, Roots, *Cotton.

A sensitivity analysis of a computer simulation of two-dimensional root, water and nitrate distributions in the soil and uptake by the plants showed that the model is more sensitive to selected environmental parameters than to plant parameters. Among the latter, the effect of the time period during which a root unit is taking up water and nitrate at a maximum efficiency is the greatest. Among the environmental factors, the sensitivity of the model is greatest for variations in maximum and minimum daily temperature. To evaluate the model, simulated and experimental results of cotton root and water content distributions in the soil during the growth period were compared. The model can reasonably predict root and water distributions in the soil under various conditions normally prevailing in the field. (Baker-FRC)
W83-02456

ESTIMATION OF SOIL WATER PROPERTIES,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. J. Rawls, D. L. Brakensiek, and K. E. Saxton.
Transactions of the ASAE, Vol 25, No 5, p 1316-1320, 1328, September/October, 1982. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Soil properties, *Water availability, *Soil moisture, Data collections, Data acquisition, Water retention, Irrigation, Hydraulics, Fluid mechanics, Conductivity, Permeability, Infiltration.

Relationships of soil water tension and hydraulic conductivity with soil water content are needed to quanitify plant available water and to model the movement of water and solutes in and through soils. Field and lab measurement of these hydraulic soil properties is difficult, laborious and costly. To provide the best estimates possible from previous analyses, a comprehensive search of the literature and data sources for hydraulic conductivity and related soil-water data was made in 1978. From this search, data for 1,323 soils with about 5,350 horizons from 32 states were assembled. From the data, the Brooks and Corey water retention parameters, soil water retention volumes at 0.33 bar and 15 bar, total porosity, and saturated conductivities for the major USDA soil texture classes were developed. Also, relationships for predicting water retention volumes for particular tensions and saturated hydraulic conductivities based on soil properties are presented. (Baker-FRC)
W83-02459

INVESTIGATIONS OF SOLUBLE SALT LOADS, CONTROLLING MINERALOGY, AND FACTORS AFFECTING THE RATES AND AMOUNTS OF LEACHED SALTS,
Montana Coll. of Mineral Science and Technology, Butte.
For primary bibliographic entry see Field 2K.
W83-02497

EFFECT OF SUBTERRANEAN DRAINAGE ON SOME PROPERTIES OF CLAY SOILS IN QUEBEC (EFFET DU DRAINAGE SOUTERRAIN SUR QUELQUES PROPRIETES DE SOLS ARGILEUX DU QUEBEC),
Department of Agriculture, Quebec. Research Station.
C. R. De Kimpe, and M. R. Laverdiere.
Canadian Journal of Soil Science, Vol 60, No 1, p 83-96, February, 1980. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Soil properties, *Drainage, *Farming, Agriculture, Rainfall-runoff relationships, Rainfall, Chemical properties, Soil chemistry, Physical properties, Manganese, Minerals, Soil management, Land management, Management, *Quebec.

To study the effect of long-term internal drainage on the physical and chemical properties of soils, four series of agricultural soils of Quebec were sampled in the Lowlands on drained and undrained sites. Change in structure was noted in the Ste-Rosalie soils. A massive layer was noted below 18 cm in the undrained profile to have been replaced by a more structured layer at greater depth in the drained profiles. Occurences of mottles down to the Cg horizon reflected the better aeration conditions in the drained sites. Saturated hydraulic conductivity values were sometimes higher and sometimes lower than those measured in the undrained profiles. Below the plow layer, the two profiles drained for more than 50 years had a cation exchange capacity 12-15% higher than the undrained profiles. Oxalate-extractable iron represented a high percentage of the dithionite-extractable iron and indicated a low rate of formation of crystalline pedogenic oxides. Manganese accumulations were in the more compact layers. The improvement of internal drainage required a soil management what would enhance soil structure. (Baker-FRC)
W83-02613

USE OF SIMILARITY SOLUTIONS FOR THE PROBLEM OF A WETTING FRONT - A QUESTION OF UNIQUE REPRESENTATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano.
Advances in Water Resources Vol 5, No 3, p 156-166, September, 1982. 30 Ref.

Descriptors: *Mathematical equations, *Wetting, *Infiltration, Soil moisture, Moisture profiles, Porosity, Soil porosity, Darcys Law.

The use of similarity solutions for the problem of horizontal infiltration of water into a semi-infinite, dry and homogeneous porous medium is studied based on some recent results of functional analysis. While the general classification of similarity solutions into two kinds by Barenblatt and Zel'dovich has been a useful guide for practical applications, no easy method has been found for exactly determining each kind, and definite classification must rely upon rigorous mathematical analysis case by case. It is concluded that the so-called non-unique representation of reported experimental moisture profiles for this problem is not necessarily evidence against the validity of the extended Darcy's law for unsaturated flow through porous media. (Baker-FRC)
W83-02638

NODAL DOMAIN INTEGRATION MODEL OF ONE-DIMENSIONAL ADVECTION-DIFFUSION,
California Univ., Irvine. Dept. of Civil Engineering.
T. V. Hromadka, and G. L. Guymon.
Advances in Water Resources, Vol 5, No 1, p 9-16, March, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Model studies, *Mathematical studies, *Mathematical models, *Advection, *Solutes, Mathematical equations, Mathematical analysis, *Soil-moisture transport.

The nodal domain integration method was applied to a one-dimensional advection-diffusion mathematical model without a source term. The advection-diffusion equation was analyzed to determine an appropriate element matrix modeling statement which incorporates the finite element, finite difference, and subdomain integration modeling approaches. Also, a higher order spatial trial function approximation between nodal points was modeled by a linear trial function approximation in a diffusion dominated process. The linear approximation effort was based on determining a higher order trial function using information on the spatial distribution of the time derivative of the state variable. A case study is presented on a Fickian dispersion process of a conservative dissolved species with solute concentration C within pure water. (Small-FRC)
W83-02657

FIELD DETERMINATION OF INFILTRATION PARAMETERS (BESTIMMUNG VON INFILTRATIONSPARAMETERN MIT HILFE VON FELDMESSUNGEN),
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
S. H. Al-Azawi, and G. W. Marotz.

Wasserwirtschaft, Vol 72, No 7/8, p 290-292, July/August, 1982. 5 Fig, 12 Ref. English summary.

Descriptors: *Mathematical equations, *Infiltration, Soil water, Capillary, Hydraulic permeability, Conductivity, Irrigation programs, Irrigation, Permeability coefficient, Capillary conductivity.

A simple graphical solution of the one-dimensional infiltration equation based on field data has been developed. Since the saturated hydraulic conductivity and the average capillary suction are the most important parameters governing the infiltration, this method serves to determine these two parameters. The unsaturated hydraulic conductivity can also be determined from these parameters and from the moisture retention function. A comparison between the results of infiltration parameters and computed values shows good agreement. This technique has wide applicability in practical problems of irrigation. (Baker-FRC)
W83-02785

2H. Lakes

PHYSICO-CHEMICAL STUDY OF DEAD SEA WATER, II. DENSITY MEASUREMENTS AND EQUATION OF STATE OF DEAD SEA WATER AT 1 ATM,
Israel Oceanographic and Limnological Research Ltd., Haifa. Chemistry Dept.
B. S. Krumgalz, and F. J. Millero.
Marine Chemistry, Vol 11, No 5, p 477-492, 1982. 3 Fig, 7 Tab, 36 Ref.

Descriptors: *Density, Physical properties, *Saline lakes, *Dead Sea, Lakes, Mixing, Electrolytes, *Salts, Ions, *Israel.

The densities of artificial solutions of Dead Sea waters were measured at 20, 25, 30, 35, and 40C using a vibrating tube densimeter. A series of 25 solutions were prepared from NaCl, KCl, MgCl2, and CaCl2 to reflect the various compositions of the water from concentrations of 246.6634 to 271.3525 g salts per 1000 g solution. Dead Sea waters are dominated by Mg(++) and chloride. Densities, which varied from 1.199027 to 1.232747 g per ml, were very sensitive to changes in ionic composition. An equation of state for Dead Sea waters was determined. Average deviation between observed and calculated values was 0.000020 g per ml. A thermal expansion coefficient and coefficients characterizing the influence of the changes in salt or ionic concentrations on density were calculated. Partial molal volumes of Na, K, Mg, and Ca chlorides were calculated for 20, 30, and 40C. The changes in partial molal volumes of NaCl, and CaCl2 with temperature were positive, and that of MgCl2, less than zero. These data are important in understanding the possible effects of the proposed canal which would bring Mediterranean Sea water into this lake. (Cassar-FRC)
W83-02464

TURBIDITY AND ITS CAUSES IN A NARROW GLACIAL LAKE WITH WINTER ICE COVER,
State Univ. of New York at Buffalo. Dept. of Biology.
K. M. Stewart, and P. J. H. Martin.
Limnology and Oceanography, Vol 27, No 3, p 510-517, May, 1982. 12 Fig, 23 Ref.

Descriptors: *Turbidity, *Seasonal variation, *Glacial lakes, *Mixing, Lakes, Coriolis force, Stratification, Destratfication, Density, Suspended solids, *New York, Hemlock Lake.

A field study was conducted of the seasonal variations in turbidity in Hemlock Lake, a narrow glacial Finger Lake south of Rochester, New York. In the summer and under winter ice cover, the turbidity structure is primarily vertical. During spring and fall mixing periods, horizontal gradients in turbidity predominate. At the southern end of the lake, inflows from the large drainage area show a Coriolis effect, with good correlations between vertical mixing and density. Turbidity seems to be associated principally with suspended inorganic matter throughout most of the year. (Geiger-FRC)
W83-02470

QUANTIFICATION OF MECHANISMS RESPONSIBLE FOR BLUEGREEN ALGAL DOMINANCE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. L. King, J. M. Repko, and C. N. Spencer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190470. Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, Michigan State Univ., East Lansing, February, 1983. 30 p, 10 Fig, 3 Tab, 42 Ref. OWRT A-115-MICH(1), 14-34-0001-1124.

Descriptors: *Light intensity, *Photosynthesis, *Carbon dioxide, *Carbon fixation, Nitrogen fixation, Algae, Sinking rate, Chorella vulgaris, Anacystis nidulans, Anabaenopsis elenkinii, Ammonia, *Michigan, *Cyanophyta, Chlorophyta, Water pollution control, Vacuolate buoyancy.

Light intensity and carbon dioxide concentration interact in a multiplicative manner to control both threshold conditions required to initiate net photosynthetic carbon fixation and the specific rate of carbon fixation by the small, non-vacuolate, bluegreen algae Anacystis nidulans. The average sinking rate of the small green alga Chorella vulgaris is constant at a rate of 0.45 cm/hr and is not altered by variation in light intensity, carbon dioxide concentration, or the presence or absence of bacteria. Buoyancy of the vacuolate, nitrogen fixing bluegreen alga Anabaenopsis elenkinii is determined by an interaction between light intensity, carbon dioxide concentration and the ammonia content of the water.
W83-02482

EFFECT OF SORPTION ON MINERALIZATION OF LOW CONCENTRATIONS OF AROMATIC COMPOUNDS IN LAKE WATER SAMPLES,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
R. V. Subba-Rao, and M. Alexander.
Applied and Environmental Microbiology, Vol 44, No 3, p 659-668, September, 1982. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Organic compounds, *Lake water, *Mineralization, Montmorillonite, Benzylamine, Kaolinite, *Aromatic compounds, Eutrophic lakes, Chemical reactions, Biodegradation, *Clays.

The influence of montmorillonite, kaolinite, and glass microbeads on the mineralization of low concentrations of organic compounds in samples from a eutrophic lake was examined. Montmorillonite/benzylamine complexes were formed immediately on addition of amine to suspensions containing the clay. The extent of amine sorbed was a linear function of equilibrium amine concentration in lake water. A larger percentage of the chemical was released from the complex during mineralization in the presence of high clay concentrations than in the presence of low clay concentrations. Montmorillonite did not enhance mineralization rates at amine levels of 200 ng/ml or lower, but it was stimulatory at 20 micrograms/ml. Except at high amine and clay concentrations, mineralization was more rapid than desorption during the early periods of decomposition when the amine concentration in solution was relatively high. Relative to the microbial demand, desorption was more rapid during later periods of decompositon when the amine level in solution was very low. Mineralization of benzoate was not usually affected by montmorillonite, kaolinite, or glass beads. More than 90% of the carbon from benzylamine and benzoate was often mineralized when the substrate concentration was 250 ng/ml or less. The data suggest that clay may have a significant effect on the microbial decomposition of low concentrations of certain organic compounds. (Baker-FRC)
W83-02554

COMPARATIVE SEASONAL UPTAKE OF GLUCOSE AND ACETATE BY EPIPHYTIC BACTERIA ON THE SURFACES OF THREE SPECIES OF MACROPHYTE IN THE LITTORAL ZONE OF LAKE OHRID, YUGOSLAVIA,
Toledo Univ., OH. Dept. of Biology.
H. L. Allen, and B. T. Ocevski.
Archiv fur Hydrobiologie, Vol 93, No 4, p 423-445, March, 1982. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Bacteria, *Epiphytes, *Organic carbon, Lakes, Lake Ohrid, *Yugoslavia, Macrophytes, Aquatic plants, Nutrients, Seasonal variation, Glucose, Acetate, Littoral zone, Kinetics, Turnover time, Enzymes, Metabolism, Adsorption.

Uptake of C14-labeled glucose and acetate by epiphytic bacteria on the surfaces of 3 macrophytes in Lake Ohrid, Yugoslavia, was measured on several occasions from June 1978 to June 1979. Uptake kinetics indicated first-order, ennzyme mediated, active transport. The mean seasonal maximum theoretical glucose uptake velocities at 0.5 m below the surface were 6.38, 22.63, and 4.38 micrograms per liter per hour per sq dm of macrophyte surface area for Phragmites, Potamogeton, and Nuphar, respectively. Acetate removals by epiphytes on the same macrophytes were 10.65, 57.00, and 18.63 micrograms per liter per hour per sq dm, repectively. The mean seasonal maximum theoretical velocities of glucose incorporation, extrapolated to the mean surface area available for colonization per sq m of littoral zone (uncorrected for respiratory losses during in situ incubations) were 15.92, 17.71, and 0.69 mg C per sq m per day at Phragmites, Potamogeton, and Nuphar sites, respectively. Corresponding acetate removals were 10.62, 44.01, and 2.22 mg C per sq m per day. Turnover times for glucose and acetate removals averaged 2.0-5.2 hours during summer thermal stratification and 5.3-132 hours during the rest of the year. Turnover times were inversely correlated with estimated maximum theoretical uptake velocities. Approximations of maximum ambient substrate concentrations of glucose and acetate physiologically available to epiphyte bacteria were 1.8-76 micrograms per liter and 0.4-379 micrograms per liter, respectively. The natural concentrations of both substrates occasionally approached zero availability. (Cassar-FRC)
W83-02556

LAKE FIDLER, A MEROMICTIC LAKE IN TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Botany.
R. D. King, and P. A. Tyler.
Archiv fur Hydrobiologie, Vol 93, No 4, p 393-422, March, 1982. 28 Fig, 1 Tab, 45 Ref.

Descriptors: *Meromictic lakes. *Chemocline, *Seasonal variation, Environmental effects, Lake Fidler, Gordon River, *Tasmania, Holomictic lakes, Anaerobic conditions, Sulfides, Bacteria, Dam effects, Lakes, Shallow water, Saline water intrusion, Monimolimnion, Chemical properties, Physicochemical properties, Water temperature, Stratification, Chlorophyll a, Light penetration, Dissolved oxygen, Oxygen, Conductivity.

Lake Fidler, one of several meromictic shallow, riverine lakes on the Gordon River, Tasmania, may revert to a holomictic state as a result of the October 1977 completion of a power station downstream. The meromictic state has been maintained by intrusion of an estuarine salt wedge, which no longer penetrates as far as the lake area. Water sampling from January 1977 to April 1978 was conducted to define the physicochemical properties of the lake water. Temperature profiles included normal stratification in December-March, inverse stratification in July and August, dichothermy in July and October, and more complex profiles on occasion. A chemocline occurred at 2.2 m. The monimolimnion was always anoxic. Sulfides in this layer increased in midsummer. At the redoxycline/oxycline a narrow stratified plate of flagellates and photoautotrophic bacteria was found. The population density was greatest in summer and lowest in winter. The color produced by the abundant humic materials attenuated the photosynthetically active radiance (PAR). Attenuation coefficients of downwelling PAR were 1.11-1.62 per m. Wavelengths below 560 nm were extinguished in the upper half meter, and very little light was present (all above 640 nm). Fidler Lake showed no signs of becoming holomictic 5 months

after the flow regulation began. However, gilvin values declined as a result of increased flows. Loss of meromictic qualities is expected to occur gradually over many years from errosion of the chemocline and wind-induced turbulence. (Cassar-FRC)
W83-02557

THE SEASONAL VARIATION OF ORGANIC CONSTITUENTS IN A EUTROPHIC LAKE, LAKE SUWA, JAPAN. PART 1, PARTICULATE ORGANIC MATTER,
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 5C.
W83-02559

TRANSPORT AND FATE OF HEAVY METALS IN ONONDAGA LAKE, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W83-02562

ACID PRECIPITATION AND LAKE SUSCEPTIBILITY IN THE CENTRAL WASHINGTON CASCADES,
Central Washington Univ., Ellensburg. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W83-02566

KINETIC FRACTIONATION OF CARBON-13 DURING CALCIUM CARBONATE PRECIPITATION,
Commonwealth Scientific and Industrial Research Organization, Floreat Park (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2K.
W83-02570

STRUCTURE AND FUNCTION OF A CYANOPHYTAN MAT COMMUNITY IN AN ACIDIFIED LAKE,
Lund Univ. (Sweden). Limnological Inst.
S. Lazarek.
Canadian Journal of Botany, Vol 60, No 11, p 2235-2240, 1982. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Oligotrophic lakes, *Cyanophyta, *Acidic water, *Benthic environment, *Hydrobiology, *Primary productivity, Lakes, Algae, Benthic flora, Benthic fauna, Midges, Diatoms, Photosynthesis, *Sweden, Lake Gardsjon.

The structural and functional properties of a cyanophytan mat community of the acidified, extremely oligotrophic lake, Lake Gardsjon of Southwest Sweden, were studied. Results showed that the blue-green algal mat forms a perennial cohesive blanket-like cover over the organic matter-rich sediment and is well adapted to the acid conditions of the lake. The surface of the mat shows an undisturbed reticular structure with an uppermost stratum (2-3 millimeters) of dense motile filaments of Lyngbya bourrellyana Compere, and to a lesser extent, Oscillatoria geminata Meneghini. Other benthic organisms and pennate diatoms are also abundant within the filamentous matrix. Chironomids reside in the surface of the mat, while the lower strata are occupied by nematodes. Relatively high rates of algal primary productivity and low rates of nitrogen fixation were recorded in the mat. Light is a principal factor limiting benthic algal photosynthesis. (Geiger-FRC)
W83-02610

THE EFFECTS OF LIMNOLOGICAL PROCESSES ON THE QUALITY OF IMPOUNDED WATERS (AUSWIKUNGEN LIMNOLOGISCHER VORGANGE AUF DIE BESCHAFFENHEIT VON STAUGEWASSERN),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt.
Wasserwirtschaft, Vol 71, No 4, p 110-111, April, 1981. 2 Fig, 1 Tab. (No English Summary).

Descriptors: *Limnology, *Reservoirs, *Water quality, *Water circulation, *Water pollution, Seasonal variation, Radiation, Wind, Lake morphology, Lake classification, Water use, Eutrophication, Phosphorus, Organic compounds, Trace elements, Nutrients, Fertilizers, Nitrogen.

Water quality is significantly altered when running water is impounded and its flow speed is reduced to 100 mm/sec or less. Radiation energy and wind exert a great influence on water > 6-8-m deep by creating a temperature-dependent stratification during summer and fall, whereby water circulation is inhibited or interrupted (stagnation). In winter and spring, circulation may be interrupted through surface-water cooling to temperatures < 4C or by ice cover. Seasonal variation with depth consequently occurs differently in concentrations of oxygen; carbon dioxide; iron, manganese, ammonium, nitrate, and sulfate ions; and dissolved organic compounds. If water retention time in the lake is > 10 days, algae and macrophytes can develop -- particularly in the mouths of feeder streams. The intensification of primary production in the lake, which is related to this phenomenon and is caused by overfertilization with nutrients, is designated as eutrophication. Phosphorus is usually the chief cause of this, at least in lakes in the Federal Republic of Germany. The Lake's morphological characteristics also play a role in bioproduction: lakes with an average depth of < 18-20 m with long shallow bays in wind-sheltered situations have short circulation periods and are therefore susceptible to eutrophication. Cultivated land above lakes can exert a negative influence on water quality. A graph showing the probability that a given lake will be oligo-, meso-, or eutrophic according to the relationship between total phosphorus concentration and time is presented, as is a table showing uses possible for lakes of differing quality. (Gish-FRC)
W83-02784

2I. Water In Plants

RHIZOS: A SIMULATION OF ROOT GROWTH AND SOIL PROCESSES. SENSITIVITY ANALYSIS AND VALIDATION FOR COTTON,
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 2G.
W83-02456

THE ADAPTATION OF VARIETIES OF SORGHUM TO DIFFERENT WATER REGIMES,
Institut National de Recherches Agronomiques au Niger, Niamey.
N. I. Jika, C. A. St. -Pierre, and J. C. Denis.
Canadian Journal of Plant Science, Vol 60, No 1, p 233-239, January, 1980. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Drought, *Sorghum, *Crop yield, Rainfall, *Plant growth, Grains.

The abilities of twelve varieties of sorghum to adapt to drought were measured on nine hybrids and three lines of various origin. Polyethylene covers were used to simulate drought conditions at five experimental locations during the 2 year study. The yield of grain was used to evaluate the stability of the plants at the sites. The hybrids demonstrated a wider adaptability than the lines used in the experiment. Correlation studies demonstrated that any relationship between yield and physiological characteristics was at best low and usually insignificant. (Baker-FRC)
W83-02612

PLANT-SUBSTRATE INTERACTIONS AND BELOW SUBSTRATE BIOMAS DYNAMICS: A CONTINUATION OF STUDIES CONCERNING POTENTIAL RESTRICTION OF THE INTRODUCED AQUATIC WEED MYRIOPHYLLUM , SPICATUM L. (EURASIAN WATER MILFOIL),
Tennessee Univ., Knoxville. Dept. of Ecology.
C. C. Amundsen, and A. L. Brenkert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191841, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Research Report No 92, Univ. of Tennessee, Knoxville, April 1982. 69 p, 11 Fig, 28 Tab, 62 Ref, 1 Append. OWRT B-044-TENN(1), 14-34-0001-9097.

Descriptors: *Aquatic weeds, Reservoirs, *Weed control, *Myriophyllum, *Substrates, Biomass, Weeds, Water temperature, *Potassium, *Nitrogen compounds, Light penetration, Wave action, Melton Hill Reservoir, Eurasian water milfoil, Clinch River, *Tennessee, Sediments.

From the study's data analysis, it was concluded that the prediction of nuisance growth of Eurasian watermilfoil depends not only on sediment phosophorus, nitrate-nitrogen and ammonia -nitrogen, but potassium levels as well. Higher water temperatures together with non-exposure to wave action and water stream flow, likely accounts for the development of the larger standing crop of Eurasian water milfoil within the study of the Melton Hill (TN) Reservoir. Myriophyllum spicatum L. was collected monthly from five study sites. Whole plant samples were collected from similar bottom contour plots via SCUBA. Sediment samples were collected using a Ponar Grab, and water solumn measurements were taken with a YSI temperature and conductivity meter. Sediment samples were air dried and sieved. Organic matter, available phosophorus, potassium and sediment pH, and sediment nitrate were determined. Sediment texture was determined gravimetrically. Plant material was partitioned into above sediment plant material, rhizomes and roots, rinsed, dried and ground. Over-dry weight, starch and ash content were determined for all potassium content. The sulfuric acid-Hydrogen peroxide technique was used to determine the tissue nutrient content and colorimetric determination of ammonium-nitrogen levels were determined by Nesslerization. Phosophorus levels via Molybdenum Blue Method and Potassium levels by Atomic Absorption Spectrophotometer. Logarithmic transformations were performed on all data prior to statistical analysis to correct for variance heterogeneity.
W83-02729

RELEASE OF FE, MN AND P IN A CALCAREOUS VERTISOL AND YIELD OF UPLAND RICE AS INFLUENCED BY PRESOWING SOIL WATER TREATMENTS,
Mahatma Phule Krishi Vidyapeeth, Rahuri (India). Dept. of Agricultural, Chemical and Soil Science.
K. R. Sonar, and R. V. Ghugare.
Plant and Soil, Vol 68, No 1, p 11-18, 1982. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Rice, *Irrigation, *Nutrients, Vertisols, Iron, Manganese, Phosphorus, Crop yield, Soil water, Chemical composition.

In an effort to increase availability of Fe, Mn, and P to upland rice crops grown in high-pH vertisols, three pre-sowing soil water treatments were compared. The three 15-day treatments were: (1) control, no irrigation, (2) field capacity (5 cm irrigation on alternate days), and (3) saturation (2 irrigations daily). At sowing time the saturated treatment increased available soil Fe from 2.89 to 4.83 ppm. Similarly the available Mn concentration was increased from about 5 to about 8.5 ppm. Increases in available P were less dramatic, from 10 to 13 ppm. As the growing season progressed, differences in available nutrient levels between control and treated plots decreased. Laboratory studies showed the following soil properties: control--8.6 pH, +501 mv Eh, 3.73 ppm Fe, 6.91 ppm Mn, and 8.96 ppm P; 15-day field capacity, 8.3 pH, 455 mv Eh, 5.51 ppm Fe, 7.98 ppm Mn, 9.77 ppm P; 15-day soil saturation, 7.9 pH, 395 mv Eh, 6.49 ppm Fe, 13.72 ppm Mn, 10,18 ppm P; 15-day submergence, 7.5 pH, 362 mv Eh, 10.49 ppm Fe, 39.61 ppm Mn, and 13.89 ppm P. The Tuljapur 1 cultivar yielded more than Karjat 184 under upland conditions. (Cassar-FRC)
W83-02797

2J. Erosion and Sedimentation

MODERN SEDIMENT ACCUMULATION AND STRATA FORMATION ON THE AMAZON CONTINENTAL SHELF,

North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2L.
W83-02463

SIGNIFICANCE OF RIVER FLOW FOR THE SUSPENDED SOLIDS BURDEN AND ITS RETENTION IN THE IMPOUNDED RUHR (BEDEUTUNG DES ABFLUSSES FUR DIE SCHWEBSTOFFFRACHT UND IHRE RETENTION IN DER GESTAUTEN RUHR),
Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
P. Klopp, and K. -H. Kornatzki.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 10, p 467-472, October, 1981. 9 Fig, 5 Tab, 15 Ref.

Descriptors: *River flow, *Suspended solids, *Reservoirs, Runoff, Sedimentation, Lakes, Morphology, Metals, Iron, Lead, Zinc, Nickel, Lake sediments, *Federal Republic of Germany, Ruhr impoundments.

The relationship between river flow and the load of suspended solids and its retention was investigated by frequent random sampling at the inflow and effluent of the Ruhr impoundment at Baldeney. Both relationships, load versus runoff and variation of load versus runoff, indicate a progressive increase at flows above 200 cubic meters/second. The morphology of the impounded lake allows maximum retention rates of about 50%. About half of the annual amount of suspended solids retained in the lake settles on only 20 days when the runoff exceeds 200 cubic meters/second. Sedimentation rates for the heavy metals iron, lead, zinc and nickel correspond with analytical data of the lake sediment, and thereby confirm the method of balance used here, which is based on a large number of random samples. (Author's abstract)
W83-02587

DEPOSITION OF SEDIMENTS ON THICKET-COVERED FLOOD PLAIN,
Yu. N. Sokolov.
Hydrotechnical Construction, No 11, p 1135-1139, November, 1980. 3 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 21-23, November, 1980.

Descriptors: *Flood plains, *Deposition, *Vegetation effects, Sand, Rivers, Sediment transport, Sediment distribution, *USSR, Podcherem River, Mana River.

Flood plain sand deposits are classified as general (small thickness, widely and uniformly spread) or local (meso- or microdeposits). Local deposits are affected by relief and vegetation. In flood plains of the Podcherem and Mana Rivers, which do not have sand fractions in the flow, no accumulations of sediment deposits were observed in places where vegetation was concentrated. Local sediment deposits downstream from different types of vegetation were studied at a bend of the Oka River flood plain near Beloomut, USSR, after a 50% frequency flood in the summer of 1978. For equal flow velocities and saturation of flow with sediments, the volume of deposits as a function of the generalized vegetation parameter varied from 0.005 cu m for a low shrub to 0.85 cu m for a shrub with a large center and weak permeability. The vegetation parameter considered the plant diameter, degree of vertical continuity, plant height and the water depth in the flood plain. Data from the rivers were used to construct graphs of sediment deposit volume and vegetative thickness. The Mologa River had a curve entirely different from those of the Ilet and Kolp Rivers. (Cassar-FRC)
W83-02605

CASE HISTORY OF SEDIMENTATION AT PELIGRE DAM, HAITI (CAS HISTORIQUE DE SEDIMENTATION DU BARRAGE PELIGRE, HAITI),
Laval Univ., Quebec. Dept. of Civil Engineering.
M. Frenette, J. P. Tournier, and T. J. Nzakimuena.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 206-223, June, 1982. 20 Fig, 4 Tab, 5 Ref.

Descriptors: *Sedimentation, *Reservoirs, Design criteria, *Silting, Erosion, Predicting, Mathematical equations, Simulation, Watershed, *Haiti, Peligre Dam, Artibonite River.

The Peligre Dam in Haiti on the Artibonite River was built in 1956 with an expected life of about 180 years. Based on sedimentation data collected in 1925 and 1926, the average rate of silting in the reservoir was estimated at 345,000 cubic meters/year. In 1979, however, an average sedimentation rate of 9,600,000 cubic meters/year was established. Systematic studies were undertaken to explain the phenomenon and predict future silting rates. The studies led to simulation, by means of a mathematical model, of the processes involved and have permitted reconstruction of the hydro-sedimentological events since 1956 as well as prediciton of the future rate of sedimentation. The main physical processes responsible for the patterns of deposition were used as common denominators: degradation of watershed and rivers, effects of deforestation, urbanization, and agriculture, effects of flocculation and consolidation, effect of the reservoir geometry, expected sediment inflow, water inflow versus outflow, and others. The model indicates very well the acceleration of the silting rate, with an average increase of about 18% per year. The study shows that the sediment inflow took the form of a quadratic or exponential growth curve. After 23 years the average silting is three times that of the design. Greater care must be taken in predicting long-term sedimentation rates in a reservoir, since the lifetime of the dam may be appreciably reduced. (Baker-FRC)
W83-02611

ESTIMATION OF THE SIZE AND ROUGHNESS OF SEDIMENTS IN HYDRAULIC CALCULATIONS,
For primary bibliographic entry see Field 8B.
W83-02622

FLUVIAL HYDRAULICS OF DELTAS AND ALLUVIAL FANS,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W83-02678

SALTATION IN WATER DYNAMICS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W83-02679

CELERITY OF TRANSIENT BED PROFILES,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1393-1397, November, 1982. 2 Fig, 6 Ref.

Descriptors: *Alluvial channels, *Mathematical equations, *Bed load, Sediment transport, Hydraulics, Channels.

Linear stability analysis was performed on the set of equations governing the flow of water and sediment in alluvial channels, assuming flows well below the critical state. The equation was reduced, assuming large values of the dimensionless wave number. The applicability of the formula obtained for the calculation of celerity of alluvial channel bed transients has been verified using data from flume experiments. The formula is easy to use; the results obtained are encouraging and show the promise of this approach in the qualitative analysis of unsteady alluvial channel hydraulics. (Baker-FRC)
W83-02694

RELATIONSHIPS BETWEEN MORPHOLOGY OF SMALL STREAMS AND SEDIMENT YIELD,
H. H. Chang, W. L. Graf, E. H. Grissinger, H. P. Guy, and W. R. Osterkamp.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1328-1365, November, 1982. 11 Tab, 181 Ref.

Descriptors: *Streams, *Morphology, *Sediment transport, Erosion, Erosion control, Model studies, Mathematical equations, Vegetation, Banks, Flow, Hydraulics, Hydrodynamics, Channels, Canals, Design criteria.

The state of the art in the relations between morphology of small streams and sediment yield is assessed. Research findings and recommendations for additional research are presented. Topics include systems and interactions, simulation models, channel forms and processes, transport of sediment in small streams, and aspects of channel morphology. Simulation models for erosion and sediment yield were reviewed, and their role in providing estimates of the upland input of water and sediment of stream channels was noted. Many of the models include channel erosion and deposition. The presence of a free water surface in open channel flow adds an element of complexity in that depth of flow is free to change in response to changing conditions. Alluvial bed forms and their relation to hdraulic resistance, and, thus, depth discharge formulas, were reviewed and found to differ depending on flow conditions. Self-forming streams in the downstream direction can be patterned as straight, meandering or braided. The patterns and associated temporal and spatial interactions are again seen as complex inasmuch as channel form can affect the gradient and countercurrents and thus channel geometry and sediment transport capacity. Sediment-transport formulas, the form and structure of stream channels, and regime theory developed from the need for design criteria for sediment carrying canals were reviewed. Calibration of hydraulic geometry equations for natural streams, the synthesis of the erosion and sediment transport methods, the effects of geologic materials, and the influence of bank vegetation on channel erosion and sedimentation were also considered. (Baker-FRC)
W83-02697

BED CHARACTERISTICS IN ALLUVIAL CHANNEL BENDS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. J. Odgaard.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1268-1281, November, 1982. 8 Fig, 28 Ref.

Descriptors: *Erosion control, *Alluvial channels, Sacramento River, *River beds, Sediments, Sedimentation, Erosion, Slope, Channels, Froude number, *California.

A new approach is presented to the description of the steady-state flow and bed characteristics in an alluvial channel bend. The approach is based on a combination of the principal of moment-of-momentum flux and a critical-shear-stress analysis. The approach is used to explain observed transverse variations of depth, depth-averaged velocity, and mean grain size in a bend of the Sacramento River, California. The local transverse bed slope was found to vary linearly with the bed-surface particle Froude number. It is established that the distributions of depth, depth-averaged velocity, and bed surface sediment size depend on the variety of grain sizes in the bed sediment. Equations for the transverse variation of depth, depth-average velocity, and mean grain size are developed which can provide a guide to the depth of bed erosion and depth-averaged velocity near the outer banks of river bends. (Baker-FRC)
W83-02698

SALTCEDAR INFLUENCE ON SEDIMENTATION IN THE BRAZOS RIVER,
Texas A and M Univ., College Station. Dept. of Range Science.
W. H. Blackburn, R. W. Knight, and J. L. Schuster.

Journal of Soil and Water Conservation, Vol 37, No 5, p 298-301, September/October, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Rivers, Streamflow, *Plant growth, *Sedimentation, Channels, Floods, Brazos River, *Saltcedar, *Texas.

Saltcedar infestations along thee Brazos River between Seymour, Texas and the river's confluence with the Clear Fork occupied 57% of the original river channel by 1979. As saltcedar established itself on sandbars and channel edges, the plants stabilized the channel sediments, causing deposition. By 1979, 3 meters of sediment had been deposited in the saltcedar-infested channel, and the river channel's width had been reduced by 89.6 meters. The presence of saltcedar and subsequent sediment deposition and channel closure in the Brazos River effectively reduced sedimentation of Possum Kingdom Lake. However, the saltcedar invasion resulted in higher flood stages for similar flow volumes, thus enlarging the area inundated by flood waters. This study thus reiterates the detrimental impact of saltcedar on stream dynamics and sedimentation. (Baker-FRC)
W83-02704

SEDIMENT DEPOSITION IN A FLOOD-RETENTION STRUCTURE AFTER TWO RECORD FLOODS IN SOUTHWESTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 4D.
W83-02705

LATERAL BED LOAD TRANSPORT ON SIDE SLOPES,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8B.
W83-02709

SEDCON: A MODEL OF NUTRIENT AND HEAVY METAL LOSSES IN SUSPENDED SEDIMENT,
Arizona Univ., Tucson. School of Renewable Natural Resources.
W. A. Gabbert, P. F. Ffolliott, and W. O. Rasmussen.
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1982 Meetings of the Arizona Section--American Water Resources Assoc., and the Hydrology Section--Arizona Academy of Science, Apr. 24, 1982, Vol 12, p 111-116. Ariz. Section, American Water Resources Assoc., Tempe. OWRT A-105-ARIZ(3), 14-34-0001-1103.

Descriptors: Water quality, *Nutrients, Hardness, *Mineral center, *Water resources management, *Watershed management, *Computer models, Model studies, *Heavy metals, Land management, *Sediment transport, Simulation analysis, Forest watersheds, SEDCON model, Southwest U.S.

A prototypical computer simulation model has been developed to aid watershed managers in estimating impacts of alternative land management practices on nutrient and heavy metal losses due to transported sediment on forested watersheds of the southwestern United States. The model, called SEDCON, allows users at remote locations with modest computer terminal equipment and commonly available data to obtain reliable estimates of nutrient and heavy metal concentrations in suspended sediment originating on uniformly-stocked, forested watersheds in the Southwest. SEDCON has been structured in an interactive mode to facilitate its use by persons not familiar with computer operations. Written in FORTRAN IV computer language, the model requires approximately 5000 words of core. SEDCON is operative on a DEC-10 computer at the University of Arizona.
W83-02734

2K. Chemical Processes

PHYSICO-CHEMICAL STUDY OF DEAD SEA WATER, II. DENSITY MEASUREMENTS AND EQUATION OF STATE OF DEAD SEA WATER AT 1 ATM,
Israel Oceanographic and Limnological Research Ltd., Haifa. Chemistry Dept.
For primary bibliographic entry see Field 2H.
W83-02464

TRANSPORT OF ION-EXCHANGING SOLUTES DURING GROUNDWATER RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W83-02478

FIELD EVIDENCE FOR SHALE MEMBRANE FILTRATION OF GROUNDWATER, SOUTH-CENTRAL MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W83-02483

INVESTIGATIONS OF SOLUBLE SALT LOADS, CONTROLLING MINERALOGY, AND FACTORS AFFECTING THE RATES AND AMOUNTS OF LEACHED SALTS,
Montana Coll. of Mineral Science and Technology, Butte.
J. J. Donovan, M. R. Miller, and J. L. Sonderegger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186502, Price codes: A05 in paper copy, A01 in microfiche. Montana Water Resources Research Center Report No 120, Montana State Univ., Bozeman, September 1981. 77 p, 19 Fig, 14 Tab, 32 Ref. OWRT A-112-MONT(1), 14-34-0001-9028, 14-34-0001-0128.

Descriptors: Geochemistry, *Saline water, *Salts, Mineralogy, Groundwater, *Ion transport, *Leaching, Cretaceous shale, Colorado group, Bearpaw formation, *Montana, Groundwater recharge, *Saline seeps, Groundwater pollution.

The quantity of soluble salts available for leaching beneath saline seep areas was assessed. The geochemical processes operating in saline groundwater systems were examined in a simulated weathering process by leaching at 55C and pH> 5.0 for 21 hours. Carbonate content and mineralogy of drill-hole samples was determined before leaching. The experimental leachates with calcium as the dominant cation were not similar to saline-seep waters discharges in the field dominated by Na+-Mg super 2+-SO sub 4 super 2 or Na+-SO sub 4 super 2- but were similar to waters from low-pH saline seeps in thin soils developed directly on Colorado Shale (Cretaceous), suggesting that the types of hydrolysis reactions observed in the laboratory occur in saline-seep systems in the unsaturated zone. Exchange reactions involving smectite also produce NA+ in leachate and field waters. Acidity not consumed by hydrolysis reactions is buffered by carbonates below the water table. New carbonates are formed in the vadose zone in the recharge area. Selenium occurs in a by-product of pyrite oxidation and dissolution and occurs in high concentrations in weathering of black shale or fresh shale-derived materials (till, colluvium). Its solubility may be controlled by organic ions as well as by inorganic phases. Aquifers in the Colorado Group and Bearpaw Formation in Montana are most susceptible to high selenium concentrations.
W83-02497

EFFECT OF SORPTION ON MINERALIZATION OF LOW CONCENTRATIONS OF AROMATIC COMPOUNDS IN LAKE WATER SAMPLES,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
For primary bibliographic entry see Field 2H.
W83-02554

ACID PRECIPITATION AND LAKE SUSCEPTIBILITY IN THE CENTRAL WASHINGTON CASCADES,
Central Washington Univ., Ellensburg. Dept. of Chemistry.
R. M. Logan, J. C. Derby, and L. C. Duncan.
Environmental Science and Technology, Vol 16, No 11, p 771-775, November, 1982. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Acid rain, *Lakes, *Precipitation, *Washington, Cascade Mountains, Alpine lakes, Mountain lakes, Acidity, Alkalinity, Sulfates, Nitrates, Acidic water, Fate of pollutants, Air pollution, Water pollution sources, Chemical properties.

Precipitation samples were collected at five sites across the Cascade Mountains in the region of Snoqualmie Pass, 25-65 mi east and windward of Seattle, Washington, from January to July 1981. The volume weighted average pH was 4.71, with sulfate the dominant anion. The average strong acid compositions (sulfate and nitrate) at the five sites were 57 to 62 equivalent % sulfuric acid. Strong acid levels were higher in summer than in winter. Sulfate deposition for 1981 in this region was estimated to be 16.0 kg per ha per year, corrected for sea salt. This compares with 16.3 kg per ha per year sulfate depostion calculated from 1978 data. Therefore, the Mt. St. Helens emissions apparently bypassed these collection sites. Twenty-nine remote lakes in the Apline Lakes Wilderness Area 3-20 miles north of the precipitation collectors were sampled in summer of 1981. None were acid (pH 5.62-7.46, median 6.86). Alkalinities were low (4.0-190, median 57 microeq per liter). Specific conductances averaged 5.8 microS per cm. Two reservoirs had pH of 7.62 and 7.83, alkalinities of 246 and 346 micro eq per liter, and specific conductances of 3.95 and 38.5 micro S per cm. All lakes, though not at present acid, were classified as susceptible to acidification. (Cassar-FRC)
W83-02566

ACIDIFICATION OF AQUATIC SYSTEMS: A CRITIQUE OF CHEMICAL APPROACHES,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. Kramer, and A. Tessier.
Environmental Science and Technology, Vol 16, No 11, p 606A-615A, November, 1982. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Hydrogen ion concentration, *Alkalinity, *Acidity, Model studies, *Chemical analysis, Sample preservation, *Pollutant identification, Measuring instruments, Sulfates, Errors, Indicators, Methyl orange, Literature review.

This review examines the basic assumptions of chemical acidification models for aquatic systems and the reliability of historical data used to indicate long-term trends in acidification of water bodies. Acidification models are based on the electroneutrality condition and carbonic acid weathering. All major ions (Na, K, Ca, and Mg) should be considered. If a model is simplified using Ca as representative of all ions, comparisons can be made only within the same basin, providing that soil/lithological-water reactions are uniform throughout the basin. Oxidation-reduction protolyte reactions involving C, N, and S are not considered in any of the models examined. Reliance on historical data must be modified in view of the fact that soft glass sample containers made before 1960 could have added alkalinity up to 100 microeq per liter to the sample during storage. Methods and instruments used in the older work should be known precisely and tried on representative samples to discover inherent errors. The pH of water stored for 5 hours in a well-aged, corroded copper rain gage was 5.9; in a bright, shiny copper container 4.39. Some older methods of determining alkalinity have changed over the years, depending on the chosen end-point color of the indicator or dilution of the indicator. A sample of low alkalinity lake water was tested by three operators. Results were pH of 4.04 + or - 0.10, alkalinity of 244 + or - 23

microeq per liter by the methyl orange method, and 162 + or - 1 by the Gran technique. Thus the older methyl orange method underestimated alkalinity in this case by about 80 microeq per liter compared with the more modern Gran technique. An equation for correcting historical color comparator pH method data produces results within + or - 0.1 pH units. (Cassar-FRC)
W83-02567

KINETIC FRACTIONATION OF CARBON-13 DURING CALCIUM CARBONATE PRECIPITATION,
Commonwealth Scientific and Industrial Research Organization, Floreat Park (Australia). Div. of Land Resources Management.
J. V. Turner.
Geochimica et Cosmochimica Acta, Vol 46, No 7, p 1183-1191, July, 1982. 4 Fig, 2 Tab, 29 Ref.

Descriptors: *Chemistry of precipitation, *Isotope fractionation, *Kinetics, *Carbon, *Calcium carbonate, Calcite, Bicarbonates, Crystal growth, Lakes, Carbonates, Thermodynamics, Minerals, Mineralogy, Equilibrium, Ions, Model studies.

In order to better understand C13 fractionation in freshwater lakes, the kinetic isotope fractionation of C13 during precipitation of calcium cabonate under open system conditions has been investigated. The isotope enrichment factor for the equilibrium of bicarbonate ions and calcium carbonate was found to vary between -0.35 + or - 0.23 and -3.37 + or - 0.36o/oo at 25 degrees, depending on the rate of precipitation and mineralogy. The enrichment of C13 in the solid carbonate phase decreased with increasing precipitation rate. The equilibrium of bicarbonate ions and calcite was estimated to be between -1.83 + or - 0.32 and -2.26 + or - 0.32o/oo based on slow precipitation trials. A surface diffusion crystal growth model was used to describe the combination of kinetic isotope effects on thermodynamic isotope fractionation during rapid diffusion controlled crystal growth. Under slow precipitation conditions, the equilibrium of calcite and aragonite was estimated as -1.4o/oo. However, during rapid precipitation this fractionation seemed reduced, and aragonite was less enriched in C13. (Geiger-FRC)
W83-02570

BORON CONCENTRATION IN THE SOIL SOLUTION UNDER IRRIGATION: A THEORETICAL ANALYSIS,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
Y. W. Jame, W. Nicholaichuk, A. J. Leyshon, and C. A Campbell.
Canadian Journal of Soil Science, Vol 62, No 3, p 461-470, 1982. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Irrigation, *Boron, *Soil chemistry, Leaching, Adsorption, Model studies, Chemical composition, Soil solution, Soil water.

Current irrigation water criteria for boron (B) are based on the B concentration of either the irrigation water or the soil saturation extract. The effects of the leaching fraction (LF) and the B adsorption capacity (BAC) of the soil on the soil solution concentration have not been considered. This study was designed to develop a predictive model relating soil solution B, concentration at equilibrium to the B concentration in irrigation water and the LF, and to show how the relationship between the B concentration of the soil solution under field conditions and the B concentration of the soil saturation extract can be modelled. The predictive model, derived from the mass balance concept, indicated that at equilibrium the value of the soil solution B in well-drained soil would be close to that of irrigation water, at the soil surface and will increase with depth with the highest value being near the bottom of the root zone where its magnitude is determined primarily on the degree of leaching. It is suggested that the B concentration of the soil saturation extract does not provide a true representation of the soil solution B. In assessing B toxicity, the saturation extract concentration should be converted to the soil solution concentration at the actual water content of the soil. (Baker-FRC)
W83-02574

SALTING-OUT OF METHANE IN SINGLE-SALT SOLUTIONS AT 25 DEGREES C AND BELOW 800 PSIA,
New Orleans Univ., LA. Dept. of Earth Sciences.
R. K. Stoessell, and P. A. Byrne.
Geochimica et Cosmochimica Acta, Vol 46, No 46, No 8, p 1327-1332, August, 1981. 8 Fig, 2 Tab, 18 Ref.

Descriptors: *Methane, *Chemical reactions, *Solubility, Geological studies, Salting-out, Gases, *Dissolved salts.

Aqueous methane solubilities are presented as a function of dissolved salt concentration at 25C and below 800 psia for 11 single salts. At constant pressure and stoichiometric ionic strength the solubilities were significantly higher in solutions containing divalent cations as compared to those containing monovalent cations; solubilities increased in solutions having a common anion in the following cation sequence: sodium, potassium, calcium, and magnesium; and with the exception of the increased salting-out effect of the carbonate anion, solubilities varied almost insignificantly between solutions having a common cation but different anions. Molal salting coefficients were derived from the experimental data for the salts. The use of salting coefficients was discussed in predicting methane solubilities in multisalt fluids equilibrated with a multicomponent gas phase. Solubility data at 25C are needed in multisalt solutions of geochemical interest to fit an empirical equation including a function of the single-salt molal salting coefficients presented in this report. (Baker-FRC)
W83-02583

ADSORPTION OF NATURAL DISSOLVED ORGANIC MATTER AT THE OXIDE/WATER INTERFACE,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. A. Davis.
Geochimca et Cosmochimica Acta, Vol 46, No 11, p 2381-2393, 1982. 12 Fig, 3 Tab, 38 Ref.

Descriptors: *Adsorption, *Organic matter, *Sediment-water interfaces, *Minerals, *Natural waters, *Chemical reactions, Geochemistry, Hydrogen ion concentration, Cations, Anions, Clay minerals, Kaolinite, Silicates.

The reactions of dissolved organic material at the oxide/water interface of inorganic minerals in freshwater systems was studied in the pH range of natural waters (3-11) by adsorption, microelectrophoresis, and photentiometric titration. The three techniques allowed the analysis of the proton stoichiometry of the surface reactions, the role of organic functional groups and surface reactions, the role or organic functional groups and surface hydrolysis in the adsorption process, and the extent of ionization of adsorbed organic compounds. Results showed that natural organic matter is readily adsorbed by alumina and kaolinite in the pH ranges studied. Adsorption takes place by the complexation of surface hydroxyls and the acidic functional group of the organic matter. Almost complete surface coverage by adsorbed organic matter may be expected to occur for alumina, hydrous iron oxides, and the edge sites of aluminosilicates. Most of the acidic functional groups of the adsorbed organic matter are neutralized by protons from solution. The organic coating may exert a great influence on the subsequent adsorption of inorganic cations and anions. (Geiger-FRC)
W83-02584

ENERGY ASPECTS OF EQUILIBRIUM CO-CRYSTALLIZATION FROM AQUEOUS SOLUTION,
Akademiya Nauk SSSR, Moscow. Inst. Geokhimii i Analiticheskoi Khimii.
V. S. Urusov.
Geochemistry International, Vol 17, No 3, p 1-16, 1980. 8 Fig, 5 Tab, 40 Ref.

Descriptors: *Equilibrium, *Energy, *Cocrystallization, Physical properties, Crystals, Solutions, Geochemistry, Salts, Miscibility, Sulfates, Carbonates, Sulfides, Aqueous solutions.

It is shown that the mixing parameters in the solid and liquid phases of the pure substances must be known, in addition to their solubilities, in order to explain observed or predicted coefficients of co-crystallization of isomorphous components from aqueous solution. A particularly large part is played by the energy characteristics of the solid-solution mixing, as these are dependent on the differences in the crystallochemical parameters of the components. The quantitative energy theory of isomorphous miscibility can then be used to calculate the equilibrium cocrystallization coefficients. Comparisons have been made with experiment for binary halides, sulfates, carbonates, sulfides, and other systems, and as a rule the agreement is good; in particular, there is a very decided improvement relative to the ideal-solution approximation. Ways are considered for incorporating the nonideal mixing of the salt components in aqueous solution. The compound-solvent concept is applied to multicomponent mixtures. An explanation is also offered for the dependence of the cocrystallization coefficients on temperature and on the the composition of the solid phase, and these arguments can be used in deducing crystallization conditions. (Author's abstract)
W83-02585

THEORY OF HYDROTHERMAL EQUILIBRIA OF MINERALS OF VARIABLE COMPOSITION,
Akademiya Nauk SSSR, Irkutsk. Inst. Geokhimii.
L. V. Chernyshev.
Geochemistry International, Vol 17, No 3, p 99-108, 1980. 31 Ref.

Descriptors: *Equilibrium, *Minerals, *Hydrothermal studies, Physical properties, Solutions, Aqueous solutions, Salts, Crystallization, Geochemistry, Physicochemical properties.

The activity-product rule is extended to solid phases of vairable composition, and complexing is incorporated, to obtain a system of equations for the equilibrium mass transfer between water-salt solution and solid phases, which applies for solid phases of constant and variable compositions. A description is given of hydrothermal equilibria in which the water-salt solution is considered as a single compound solvent in relation to the deposited minerals. The equilibrium relations between the mineral and the aqueous solution derived for the ion activities still apply within the framework of the complex-solvent model in terms of the overall concentrations of the deposited components. One expects little variation in the overall cocrystallization coefficients under hydrothermal conditions in spite of fairly wide variations in the physicochemical parameters. This indicates prospects for a laboratory study of hydrothermal conditions in spite of fairly wide variations in the physicochemical parameters. This indicates prospects for a laboratory study of hydrothermal equilibria of minerals of variable composition, which act as indicators for the relations between the bulk metal concentrations in hydrothermal solution. (Author's abstract)
W83-02586

ACID-BASE EQUILIBRIUM DURING PHOTOSYNTHESIS IN WATER,
Moscow State Univ. (USSR).
V. S. Savenko.
Hydrobiological Journal, Vol 17, No 6, p 86-92, 1981. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Photosynthesis, *Model studies, *Chemical reactions, Water chemistry, Organic compounds, Carbonic acids, Boric acid, Surface waters, Natural waters, *USSR, Mozhaysh reservoir.

Using mixed dissociation constants for carbonic and boric acids and instability constants for hydroxocomplexes, a theoretical dependence of total concentration of carbon dioxide in sea and lake water on pH is obtained. Experiments on simulat-

ing photosynthesis in water (bubbline of air without carbon dioxide) and full-scale observations of production-decomposition processes conducted in Mozhaysk reservoir showed satisfactory agreement with a theoretical model. The pH-based analysis of production-decomposition processes in promising for classification of fresh and sea water. The data obtained indicate that the daily curve of photosynthesis fits the model of a closed system. In attempts to extend this model to longer periods of time it is necessary to take into account the rate of exchange of carbon dioxide and oxygen between the water and air. (Baker-FRC)
W83-02600

HYDROCHEMICAL EVOLUTION OF THE EAST MIDLANDS TRIASSIC SANDSTONE AQUIFER, ENGLAND,
Institute of Geological Sciences, London (England). Hydrogeology Unit.
W. M. Edmunds, A. H. Bath, and D. L. Miles.
Geochimica et Cosmochimica Acta, Vol 46, No 11, p 2069-2081, 1982. 8 Fig, 4 Tab, 29 Ref.

Descriptors: *Aquifer, *Geochemistry, *Groundwater dating, *Geohydrology, *Aquifer characteristics, Anions, Cations, Trace metals, Trace elements, Model studies, Carbon radioisotopes, Dolomite, *England, East Midlands, Sherwood Sandston aquifer.

A detailed hydrogeochemical analysis was made of the red-bed Sherwood Sandstone (Triassic) aquifer of the East Midlands of England. A radiocarbon model has been used on this area to establish a chronology of groundwaters along the flow line. Groundwater evolution is dominated by carbonate and sulfate mineral solution, precipitation, and oxidation-reduction reactions. Three distinct chronological zones have been identified. In the most recent groundwater supplies of the past 100 years, an oxidizing environment prevails which is dominated by the congruent dissolution of dolomite and inputs of anthropogenic and atmospheric sources. In groundwater of 1,000-10,000 years of age, predominantly reducing conditions prevail along with incongruent dissolution of dolomite. In groundwater over 10,000 years of age, reducing conditions also prevail, but with an approach to isotopic and chemical equilibrium in the carbonate system and a dominance of gypsum dissolution. The principal geochemical reactions and recharge history of the aquifer control the minor and trace element variation. The concentrations of transition metals and other elements are low. Only lithium and potassium ions are added by reactions of silicate minerals. The only additions considered to be of anthropogenic sources are enhanced sulfate and nitrate ions and possibly copper, zinc and lead in the most recent groundwater zone. (Geiger-FRC)
W83-02616

HYDRODYNAMIC CONDITIONS FOR COMPUTER SIMULATION OF PHYSICOCHEMICAL INTERACTIONS IN A WATER-ROCK SYSTEM IN HYDROGEOCHEMICAL FORECASTING: APPLICATION TO CAF2 WITH SOLUTIONS OF VARIOUS COMPOSITIONS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
S. R. Kraynov, B. N. Ryzhenko, Yu. V. Shvarov, L. V. Vasil'kova, and L. P. Kraynova.
Geochemistry International, Vol 17, No 3, p 17-29, 1980. 5 Fig, 1 Tab, 31 Ref.

Descriptors: *Model studies, *Hydrodynamics, *Forecasting, Geochemical studies, Calcium fluorides, Equilibrium, Groundwater, Geohydrology.

Advantages and disadvantages are demonstrated for computer simulation of the interactions in heterogeneous water-rock systems; equilibrium-thermodynamic methods can be used in elucidating and forecasting hydrogeochemical phenomena. The limits to the application of such simulations are governed by the hydrodynamic conditions related to the state of chemical equilibrium. The actual rates of infiltration of groundwater are low in hydrogeological structures, while the areas of the aquifers within which the heterogeneous systems come to equilibrium may be considerable. This provides great possibilities for applying computer simulation to hydrogeochemical processes in order to elucidate and forecast hydrogeochemical phenomena. (Author's abstract)
W83-02617

DIURNAL VARIATIONS IN ELECTRICAL CONDUCTIVITY OF WATER IN A SMALL STREAM,
Uppsala Univ. (Sweden). Dept. of Hydrology.
U. M. Calles.
Nordic Hydrology, Vol 13, No 3, p 157-164, 1982. 5 Fig, 14 Ref.

Descriptors: *Streams, *Conductivity, *Drainage basins, Diurnal distribution, Chemical properties, Evapotranspiration, Tidal effects, Hydrology, *Sweden.

Diurnal fluctuations in electrical conductivity of water have been noted in a small stream draining a basin 12 square km in size, Kassjoan in Central Sweden. An attempt to explain the cause of these variations is presented. The two influencing factors studied are evapotranspiration and earth tide effects. The bedrock of the catchment is granites, and overburden is till. Bogs cover about 19% of the area, and lakes, 1.3%. Intense forestry in the area has produced large clearcuttings in the drainage basin. Simulation studies suggest that evapotranspiration is at least partly responsible for the diurnal variation in electrical conductivity. In order to study the eventual impact of earth tides on the variation of conductivity 25 precipitation-free days were used. The mean daily variation was computed and subtracted from the series in order to eliminate the influence from meteorological factors with a period of 24 hours. The influence of gravity changing phase during the investigation may also play a part in the findings. The influence from gravity variations is not as clear as that of evapotranspiration and cannot yet be explained. (Baker-FRC)
W83-02776

ACIDIFICATION OF GROUNDWATER IN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
A. Henriksen, and L. A. Kirkhusmo.
Nordic Hydrology, Vol 13, No 3, p 183-192, 1982. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical properties, *Groundwater, *Acidification, Water properties, *Norway, Surface waters, Lakes, Streams, Alkalinity, Acid rain, Precipitation, Calcium, Magnesium, Sulfates, Chemical composition.

The chemistry of ground and surface water in areas of similar geologic settings were compared by plotting the equivalent concentrations of each component on an XY-diagram. The deviations of each chemical component from the line through the origin and the plot of the two ionic sums (line of proportional composition) give information about the differences in composition of the two types of water. If it is assumed that the geologic conditions of the ground and surface waters are similar when the plots of calcium and magnesium fall close to the ionic sum line, then it is found that the alkalinity is relatively higher and the sulfate concentration is relatively lower in groundwater than in surface water. These findings suggest that in areas influenced by acid precipitation the groundwater is acidified less than the surface water. The groundwater stations studied so far show a regional tendency toward lower pH values in areas where regional lake surveys show low pH in surface waters. These areas include southernmost Norway and parts of eastern Norway. (Baker-FRC)
W83-02793

2L. Estuaries

MODERN SEDIMENT ACCUMULATION AND STRATA FORMATION ON THE AMAZON CONTINENTAL SHELF,
North Carolina State Univ. at Raleigh. Dept. of Marine, Earth and Atmospheric Sciences.
S. A. Kuehl, C. A. Nittrouer, and D. J. DeMaster.
Marine Geology, Vol 49, No 3-4, p 279-300, 1982. 12 Fig, 1 Tab, 42 Ref.

Descriptors: *Sediment transport, *Sedimentation, *Deltas, *Continental shelf, *Amazon River estuary, Mud, Graphical methods, River mouth, Radioactive tracers, Sand, Sedimentology, Suspended solids, Stratification, Estuaries, Benthic fauna, Jets, *Brazil, Atlantic Ocean.

The formation of fine-scale (<50 cm) strata on the Amazon continental shelf was studied using radiographic and Pb 210 techniques. Three distinct sedimentary areas were identified within the inner shelf mud deposit. The first, comprised of interbedded mud and sand, extended from the river mouth across the inner shelf and exhibited high rates of sedimentation. High sediment accumulation also occurred in a second region consisting of faintly laminated muds on both flanks of the corridor. Relatively low sediment accumulation rates were found in a third region of bioturbated muds. An inverse relationship was observed between sediment accumulation rate and the extent of sedimentary structure alteration by benthic fauna. A first-order sediment budget shows that sediment accumulation on the Amazon shelf between the Brazil-French Guiana border and the Para River nearly equals estimates of sediment discharged by the Amazon River. The present data suggest that the Amazon inner shelf mud deposit is a subaqueous delta prograding seaward over relict basal sands and that a turbulent jet emanates from the river mouth with competence to carry sand as bedload across the inner shelf. The presence of cross-bedded sands in the corridor of interbedded mud and sands supports the theory of a turbulent jet. The faintly laminated muds may be due to rapid deposition of suspended sediments on either side of the jet. (Geiger-FRC)
W83-02463

BEHAVIOR OF URANIUM IN TWO ESTUARIES OF THE SOUTHEASTERN UNITED STATES,
Tokyo Univ. of Fisheries (Japan).
M. Maeda, and H. L. Windom.
Marine Chemistry, Vol 11, No 5, p 427-436, 1982. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Uranium, Rivers, *Mixing, *Estuaries, Seawater, Tracers, Ogeechee River, Savannah River, Salinity, Particulate matter, *Georgia, *Path of pollutants.

Determination of uranium in water and sediment samples in the Ogeechee and Savannah River estuaries and in the Gulf Stream during December-June 1979-80 indicated that U was removed from estuarine waters at low salinites during low discharge, most likely through precipitation with Fe and Mn and/or flocculation with organic matter. Over half of the Savannah basin lies in the Piedmont Plateau, which contains higher concentrations of U than are in the Coastal Plain soils in which the Ogeechee flows. For Ogeechee and Savannah, respectively, the U concentrations (micrograms per liter) were: dissolved, 0.040-0.051 and 0.026: particulate, 0.028-0.057 and 0.101; and total, 0.073-0.108 and 0.127. Gulf stream samples averaged 3.46 micrograms per liter U. U concentrations (micrograms per liter) in the sediment particles larger than 3 microns were 0.029-0.050 in the Ogeechee and 0.088-0.204 in the Savannah. In the rivers the U234/U238 ratios in dissolved U were 1.04 + or - 0.04 to 1.08 + or - 0.12 vs 1.15 in the seawater. Particulate U234/U238 ratios in the rivers were 0.70 + or - 0.27 to 1.18 + or - 0.20. The small difference in U concentrations between the 2 rivers showed that it was not feasible to use U as a tracer to determine the influences of each river on coastal water. (Cassar-FRC)
W83-02465

SEASONAL VARIABILITY OF BIOLOGICAL ARSENIC METHYLATION IN THE ESTUARY OF THE RIVER BEAULIEU,
Southampton Univ. (England). Dept. of Chemistry.

For primary bibliographic entry see Field 5B.
W83-02471

ENERGY FLOW IN A TIDAL FLAT ECOSYSTEM,
Nederlands Inst. voor Onderzoek der Zee, Texel.
B. R. Kuipers, P. A. W. J. deWilde, and F. Creutzberg.
Marine Ecology, Vol 5, No 2, p 215-221, May, 1982. 2 Fig, 1 Tab, 38 Ref.

Descriptors: *Tidal flats, *Energy, *Food chains, *Trophic level, *Macroinvertebrates, *Ecosystems, Tidal marshes, Primary productivity, Aquatic productivity, Secondary productivity, Benthos, Aquatic animals, Aquatic plants, Wadden Sea, *The Netherlands.

The transfer of energy through a tidal flat biosystem in the western Wadden Sea is reevaluated. Previous concepts of energy flow through such ecosystems have maintained that the secondary level is primarily herbivorous macrobenthos with an excessive primary food supply and that the higher trophic levels are food limited. A modified concept of energy flow, based on available estimates of primary production, input of allochthonous organic matter, and consumption and production at different trophic levels is proposed, which establishes the importance of the 'small food web' as a source of food for macrobenthos. This group, in addition to bacteria, consists of microfauna, meiofauna, temporary meiofauna, and small macrofauna. It is proposed that the small food web contributes far more to primary consumption and to the production of food for small carnivores than has generally been assumed in food chain studies conducted in the western Wadden Sea. (Geiger-FRC)
W83-02475

CARBON INPUTS TO BIVALVE MOLLUSKS: A COMPARISON OF TWO ESTUARIES,
Washington Univ., Seattle. School of Fisheries.
L. S. Incze, L. M. Mayer, E. B. Sherr, and S. A. Macko.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 10, p 1348-1352, October, 1982. 2 Fig, 2 Tab, 20 Ref.

Descriptors: *Organic matter, *Mollusks, *Isotope studies, *Carbon isotopes, Estuaries, Rivers, Sheepscot estuary, Damariscotta Estuary, *Maine, Invertebrates.

Carbon isotope ratios of particulate organic carbon (POC) and tissues of bivalves were studied in two Maine estuaries: Sheepscot, which has extensive river input, and Damariscotta, which has little river input. Delta C13 values (in o/oo) in Sheepscot varied from -23.8 to -25.0 in POC and from -18.7 to -21.8 in bivalve tissue; in Sheepscot tributaries, -24.2 to 25.3 in POC and -22.0 to -22.5 in bivalve tissue; in Damariscotta, from -21.0 to -22.0 in POC and -16.5 to 18.8 in bivalve tissue. Delta C13 values in Sheepscot showed a systematic landward decrease, whereas values for the Damariscotta were nearly uniform throughout its length. In some locations departures from the trends were seen as a result of locally abundant, isotopically distinct macrophytes in an area of seasonally low flushing or surface deposit feeding on benthic microalgae with anomalously high delta C13 values. (Cassar-FRC)
W83-02548

WATER EXCHANGE BETWEEN SEA AND OPEN ESTUARIES OF THE NORTHWESTERN COAST OF THE BLACK SEA,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. M. Timchenko, V. L. Gil'man, and B. P. Nadtochiy.
Hydrobiological Journal, Vol 17, No 6, p 81-85, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Water exchange, *Seas, Hydrochemistry, Hydrology, *Black Sea, Estuaries, Tides, Winds, *USSR.

The exchange of water with the sea is an important factor in the hydrology, chemistry and hydrobiology of the estuaries of the northwestern coast of the Black Sea. In the final analysis this exchange determines the economic importance of each of these estuaries, its biological productivity and fish crop. The study demonstrates that tidal- and wind-tide-induced changes in the sea level are the determining factors in water exchange between the sea and the open estuaries of the northwestern coast of the Black Sea. A method is proposed for quantitative determination of the rate of the water exchange between the sea and the estuaries, based on hydrometeorological and astronomic data. However, its extension for other estuaries requires full scale hydrological investigations similar to those described. (Baker-FRC)
W83-02601

TIDAL WAVE ANALYSIS FOR ESTUARIES WITH INTERTIDAL FLATS,
Hanover Univ. (Germany, F.R.). Lehrstuhl fuer Stroemungsmechanik.
K. -P. Holz, and G. Nitsche.
Advances in Water Resources, Vol 5, No 3, p 142-148, September, 1982. 8 Fig, 13 Ref.

Descriptors: *Estuaries, *Tidal waves, *Finite element method, Mathematical studies, Intertidal areas, Model studies, Hydrodynamics, Channel flow, Flow analysis, Tidal flats, Tidal currents, German Bight, *Federal Republic of Germany.

Simulation of the flow in interidal flats structured by deep tidal channels is rather complicated. It can be performed in different ways which depend on the main interest of the investigation. If a tidal wave propagation must be analyzed in a deep water region which is only slightly influenced by the dynamics on the flats, rather simple strategies may be used. But if the flow on the flats themselves has to be modelled, more accurate strategies must be applied. This is demonstrated in two examples. An application of such analysis was made during an investigation on the island Minsener Oog in the German Bight. This island is an artificial island, formed from deposits from extended dredging of navigation channels. The island itself is fortified by an irregular system of groynes. For the computation, a grid net with 764 nodes and 1396 elements was used. Only by this refinement local details could be reproduced satisfactorily. The time step of the computation was 15 sec. The flow field during rising water is diagramed. It is evident that the numerical model represents many details correctly, even locally observed eddies. (Baker-FRC)
W83-02637

TROPHIC ENERGETICS IN ACRTIC FRESHWATER ECOSYSTEMS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. M. Schell, and P. Ziemann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191882. Price codes: A03 in paper copy, A01 in microfiche. Completion Report 8-11, February 1983. 30 p, 8 Fig, 2 Tab, 12 Ref. OWRT A-069-ALAS(2), 14-34-0001-2101.

Descriptors: *Aquatic productivity, Primary productivity, Food chain, Food pyramids, *Food webs, Limnology, Rivers, Ecology, *Detritus, Aquatic life, Alaskan rivers, *Alaska, Colville River, Harrison Bay, *Organic carbon, *Anadromous fish.

The inputs of organic carbon from the Colville River and from shoreline erosion to Harrison Bay dominate the energy input to this system. This large input of aliochthonous carbon is utilized by microorganisms and the secondary production is sampled from Harrison Bay during November, based on the carbon-14 content of the amphipods. The anadromous fishes entering marine waters attain an isotopic composition typical of marine fishes by late summer. Upon entering the freshwater system, however, the foodweb dependencies shift drastically and by spring, the anadromous fishes sampled (least cisco, broad whitefish) were almost completely derived from peat as indicated by a large depression in C-14 content. These data indicate two critical facts regarding anadromous fish populations: 1. Overwintering anadromous fishes in the Colville River feed actively and turn over their entire body carbon. They do not overwinter on fat reserves acquired during summer marine feeding. 2. Overwintering fishes are heavily dependent upon peat as an energy source, probably via insect larvae as principal consumers. By June, least cisco and broad whitefish are 69-65% peat carbon.
W83-02735

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

STUDY OF ICE CRYSTAL FORMATION IN TUBES UNDER STEADY FLOW CONDITIONS AS RELATING TO FREEZE DESALINATION,
Chicago Bridge and Iron Co., Oak Brook, IL.
W. S. Schoerner, T. R. Carbery, and T. J. Nowak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190462, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, July 1981. 95 p, 25 Fig, 12 Tab, 20 Ref. 4 Append. OWRT C-80326-S(No 8555)(1), 14-34-0001-8555.

Descriptors: *Desalination, *Freezing, *Crystallization, Conceptual desigm, Eutectic, Permeability, Heat transfer, *Indirect freeze crystallization, Surface freezing.

A test loop was assembled to investigate several designs for indirect freeze crystallization of brine solutions. Various parameters were monitored to determine the conditions that allow successful production of ice crystals in the flowing brine. At certain stages in this investigation, problems were identified and modifications were made to correct the difficulties. The initial cyrstallizer was an aluminum double pipe heat exchanger which was not effective because of ice blockage of the brine flow. The first major breakthrough was achieved with tubular and falling film crystallizers. Specific plastic films and surface treatments were helpful in eliminating ice adhesion. The effects of brine concentration, flow rate, heat flux, and ice fraction were studied to ascertain favorable parameters for ice crystal production. Based on the experimental work described in this report, a conceptual design for a 2000 gallon per day indirect freeze crystallizer was prepared. Additional experimental data included as amendments to this contract are presented in Appendices 3 and 4. These sections cover the determination of ice crystal size and investigation of the indirect freeze process for eutectic crystallization.
W83-02481

SIDESTREAM TREATMENT OF HIGH SILICA COOLING WATER AND REVERSE OSMOSIS DESALINATION IN GEOTHERMAL POWER GENERATION,
Permutit Co., Inc., Paramus, NJ.
A. B. Mindler, and S. T. Bateman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190678, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, January 1981. 75 p, 10 Tab, 12 Fig, 11 Ref, 3 Append. OWRT C-90093-D(No 9527)(1), 14-34-0001-9527.

Descriptors: *Silica, *Cooling water, *Geothermal power, *Reverse Osmosis, *Desalination, *Water reuse, *Corrosion, Pilot plants, Iron oxides, Idaho.

Bench scale and pilot plant test work has been performed on cooling water for silica reduction and water reuse, at DOE's Raft River Geothermal Site, Malta, Idaho in cooperation with EG&G(Idaho), Inc. Technical supervision was by Permutit. A novel process of rusting iron shavings was found effective and economical in reducing silica to less than 20 mg/l. Reverse Osmosis was investigated for water reuse after pretreatment and ion exchange softening. The original objective of

treating only a sidestream of the circulating water had to be modified in the course of field work for the following reasons: Corrosion tests on carbon steel indicated that the chloride content of circulating water had to be greatly reduced to minimize chloride pitting. The planned corrosion inhibition by chromate was recognized as no longer environmentally acceptable, requiring evaluation of nonchromate inhibition. The economies of the rusting iron process made it desirable for desilicizing geothermal make-up water in addition to sidestream treatment. Due to the short operating time available, the pilot plant work was limited to study of the individual unit operations instead of a complete system. Demonstration as an integrated system is planned in a continuation program.
W83-02486

NOVEL POLYMERS IN ASYMMETRIC AND COMPOSITE REVERSE OSMOSIS MEMBRANES,
Gulf South Research Inst., New Orleans, PA. Polymer Dept.
I. Cabasso, and B. L. Zimny.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-189977, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, February 1981. 94 p, 63 Fig, 6 Tab. OWRT C-80315-S(No 8540)(1), C-90254-S(No 9420)(1).

Descriptors: *Permselective membranes, *Semi permeable membranes, *Reverse osmosis, Saline water conversion, Brackish water conversion, *Desalination, Membrane processes, Desalination apparatus, *Asymmetric(Anisotropic) membranes, *Poly(Bromophenylene oxide dimethyl phosphonate ester), * Poly(Phenylene oxide dimethyl phosphonate ester), *Alkaline-resistant RO membranes, *Chlorine-resistant RO membranes, Membrane morphology studies.

Synthesis and optimization of symmetric (anisotropic) membranes for reverse osmosis from specially tailored polymers was investigated. The polymers consisted of a hydrophobic skeleton, poly(2,6-dimethyl-1,4-phenylene oxide)-PRO, modified with hydrophilic pendent moieties, dimethyl or diethyl phosphonate ester groups. The hydrophilicity of the resulting polymers was controlled by the degrees of phosphonate substitution, while characteristic properties of the hydrophobic skeleton guarded against matrix collapse or gross dimensional changes upon exposure to wet-dry cycles. Because of this unique structural stability, it was possible to carry out an extensive investigation of asymmetric membrane morphology by scanning electron microscopy before and after testing. An ultrathin skin resting on a porous matrix was observed in all relevent reverse-osmosis membranes. The mechanical properties, chemical resistance and transport characteristics of the membranes were evaluated with a variety of feed solutes, at pH extremes, against temperature gradients and with excessive levels of chlorine for periods up to seven months. Membranes were prepared for both low and hydraulic pressure applications which have flux and salt separation (5-50 gfd corresponding to 85-90% salt rejection). Membranes prepared from brominated polyphosphonate displayed excellent chlorine resistance. All membranes were operative in alkali up to pH 13.5; salt separation actually increased with rising pH.
W83-02502

EFFECT OF RECOVERY ON DESALINATION OF THE BLACK SEA WATER BY REVERSE OSMOSIS,
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
I. Dobrevsky, V. Mavrov, and B. Bonev.
Desalination, Vol 41, No 2, p 209-214, 1982. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Ultrafiltration, *Desalination plants, Pretreatment of water, Water treatment, Chlorination, Sedimentation, Membrane processes. Filtration, Salt water, Turbudity, Black Sea, *Bulgaria, *Freshwater recovery.

Freshwater recovery was studied during Black Sea water reverse osmosis desalination with cellulose acetate tubular membranes. Two kinds of pretreatment units were evaluated for removal of turbidity components such as colloidal particles, bacteria, and microorganisms. Pretreatment was by chlorination, sedimentation, in-line coagulation, filtration on up-flow multi-media filter, polishing sand filtration, and dechlorination, or by sand filtration and ultrafiltration. Ultrafiltration was found to be an effective alternative pretreatment. With up to 30% recovery, product flux, salt and specific ionic rejection were fairly stable in RO desalination. No technological advantages were found for Ca ion removal before RO desalination using tubular membranes. The RO system was used with water from the Burgas region, with a salinity of 16,000 to 18,000 mg/liter. (Small-FRC)
W83-02522

PERFORMANCE EVALUATION AND PROCESS DESIGN OF AN ELECTODIALYSIS PLANT BY OVERPOTENTIAL MEASUREMENTS,
Istituto di Ricerca sulle Acque, Rome (Italy).
R. Passino, C. Marra, A. Rozzi, and G. Tiravanti.
Desalination, Vol 41, No 2, p 181-197, 1982. 8 Fig, 1 Tab, 18 Ref.

Descriptors: *Desalination, *Electrodialysis, *Desalination plants, *Boundary layers, Membrane processes, Electric currents, Conductivity, Water treatment, *Italy.

The Ionics Mark III electrodialysis plant stack was evaluated as a series of elementary subsystems. Concentration boundary layer over-potentials were measured at different locations along the membrane flow path. There is a correlation between the boundary layer overpotential and other parameters, including voltage applied, current density, and bulk and interfacial concentrations. These correlations were used to develop a design procedure for a regular scale ED unit, specifically the Ionics Mark III stack. Equations are presented for the calculation of the concentration boundary layer thickness based on electrical parameters and for the calculation of the boundary layer overpotential. With this method, polarization conditions in large scale plants can be monitored using suitable reversible electrodes. (Small-FRC)
W83-02523

SHIP-MOUNTED SEAWATER 2500 CU M/D FLASH EVAPORATION PLANT FOR ADU DHABI. ECONOMICAL DRINKING WATER FOR ARID REGIONS,
Buckau-Walther A.G., Essen (Germany, F.R.). Water Engineering Div.
K. Wangnick.
Desalination, Vol 41, No 2, p 171-180, 1982. 7 Fig, 1 Tab.

Descriptors: *Desalination plants, *Desalination, *Floating plants, *Water treatment facilities, *Drinking water, Water treatment, Demineralization, Water shortage, Industrial plants, *United Arab Emirates, *Adu Dhabi.

The first self-propelled floating seawater desalination plant built for commercial use consists of a pontoon-like hull carrying two centrally positioned desalination units of 1250 cu m each. It will supply islands, coastal towns, and major construction sites in the United Arab Emirates with drinking water as well as provide a backup to existing desalination plants to alleviate plantation water shortages. With an annual output of 821,250 cu m of drinking water, a depreciation period of 20 years, and an interest rate of 10%, one cu m of drinking water from a floating unit costs 3.14 DM, while from a typical onshore unit it costs 4.43 DM. Floating plants are cost efficient for remote areas, offer lower water production costs, have a shorter water delivery period, and are available for emergencies. (Small-FRC)
W83-02524

OPERATION OF MEFF DESALINATION PLANT (MULTIPLE EFFECT FALLING FILM PROCESS),
Toyo Engineering Corp., Tokyo (Japan).
S. Kido.
Desalination, Vol 41, No 2, p 127-136, 1982. 6 Fig, 2 Tab, 3 Ref.

Descriptors: *Desalination plants, *Desalination, *Evaporators, *Condensers, Water treatment, Demineralization, Industrial plants, Brines, Water treatment facilities, Abu Dhabi, *United Arab Emirates.

A 2273 cu m/day MEFF (Multiple Effect Falling Film) sea water desalination plant was constructed in Abu Dhabi, United Arab Emirates. The plant, which consists of evaporators, preheater, condenser, and deaerators, is now in continuous operation. Productivity and utilities consumption data indicate that the plant could continuously produce the distillate at 105% of designed value, which is limited by the steam generation capacity of the boiler. The pH value of the brine in the evaporator has been extremely stable. The plant can operate continuously and steadily within a load flexibility range of 20 to 100%. This plant was tested in Japan, then disassembled for transport to Abu Dhabi. (Small-FRC)
W83-02525

MATHEMATICAL MODEL OF A MECHANICAL VAPOUR COMPRESSION EVAPORATOR. APPLICATION TO SEAWATER DESALTING. PART I-THE MODEL SETTLEMENT,
Institut de Genie Chimique de Toulouse (France).
D. Aussenac, S. Domenech, and M. Enjalbert.
Desalination, Vol 41, No 2, p 137-169, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Desalination, *Evaporators, *Desalination plants, *Mathematical models, Mathematical equations, Pilot plants, Condensers, Water treatment, Water treatment facilities, Demineralization, France.

The performance of a mechanical vapor compression evaporator was analyzed for the production of fresh water by seawater desalination. A mathematical simulation model was developed for the system. The pilot plant was designed for the produciton of 75 cu m/day of freshwater from seawater varying in temperature from 15 to 35 deg C with a salinity between 30 and 35 g of mineral salts/kg. The plant first boils the seawater in an evaporator-condenser, then the vapor passes through a compressor. Non-condensables are extracted. Equations were developed for the overall mass and heat balance as well as for the partial mass balance of each modulus. The algebraic system which must be solved consists of 265 unknowns and 215 equations. Part II of this work will identify model parameters. (Small-FRC)
W83-02526

WORLD'S FIRST SOLAR POWERED REVERSE OSMOSIS DESALINATION PLANT,
Water Services of America, Inc., Milwaukee, WI.
W. W. Boesch.
Desalination, Vol 41, No 2, p 233-237, 1982. 5 Fig.

Descriptors: *Desalination, *Desalination plants, *Reverse osmosis, *Drinking water, *Electric power, Digital computers, Logging (recording), Mathematical models, Water treatment, Jeddah, *Saudi Arabia, Red Sea.

The World's first solar-powered seawater reverse osmosis plant which is operating in Jeddah, Saudi Arabia, on the eastern shore of the Red Sea, is described. The system provides for the drinking water needs of a community of 250 people and also provides power for a complete digital logging system. The RO system has two membrane stages. The 42,800 ppm salinity water enters two parallel-connected DuPont B-10 permeators after acidification and filtration. Product water is then repressurized and pumped to two B-9 permeators, reject-staged. Overall recovery is 22% with a product flow of 1.2 gallons per minute. A digital computer records 48 variables every six minutes. The data are being used to verify computer models. The plant power source is an 8 kW (peak) array of

ribbon photovoltaic modules. Overall array efficiency is 7.5%. (Small-FRC)
W83-02547

DEVELOPMENT OF FT-30 MEMBRANES IN SPIRAL WOUND MODULES,
FilmTec Corp., Minneapolis, MN.
R. J. Petersen, J. E. Cadotte, and J. M. Buettner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191775, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, October 1982. 76 p, 14 Fig, 10 Tab, 9 Ref. OWRT C-80318-S (No 8547)(1).

Descriptors: *Desalination, *Reverse osmosis, *Permselective membranes, *Semipermeable membranes, Seawater, Brackish water, Desalination apparatus, Chlorine, Polymers.

The objective of this program was to enhance the development of a new thin-film-composite desalination membrane, named FT-30, into commercially attractive spiralwound reverse osmosis elements for seawater and low pressure brackish water applications. This membrane consists of a novel crosslinked aromatic polyamide formed on microporous polysulfone, itself supported by woven or nonwoven polyester webs. Studies centered on the optimization of polysulfone substrate and membrane fabrication parameters, and long term tests on FT-30 spiral elements on tapwater, brackish water and sweater. FT-30 membrane elements showed 15 gfd and 98% salt rejection towards 0.3% TDS brackish water at 200 psi and 25C in a two year test. Single pass seawater desalination was demonstrated in concurrent seawater trials. The membrane was not fully resistant to chlorine, showing salt rejection losses after 500 to 1500 hours exposure to 0.5 ppm chlorine, but was stable during 4000 hours exposure to chlorine dioxide.
W83-02722

POLARIZATION PHENOMENA IN ELECTRODIALYSIS SYSTEMS,
California Univ., Berkeley. Water Thermal and Chemical Technology Center.
J. Sinkovic, T. Vermeulen, and C. C. Herrmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191866, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, June 1982. 49 p, 19 Fig, 4 Tab, 5 Ref, 3 Append. OWRT C-90164-S(No 0436)(1), 14-34-001-0436.

Descriptors: *Electrodialysis, *Ion-exchange membranes, *Diffusion layer thickness, *Transport number, *Limiting current desity, Prediction, Voltage drops, Computer programs, Membrane processes, *Desalination.

Two single ion-exchange membranes, one anionic (Ionics, 103 QZL-386) and one cationic (Ionics, 61 CZL 386) were investigated in 0.01 N KCl at several velocities. The limiting current density, (l.c.d.) was found to vary with the method employed, implying a range rather than a unique value. The data were used to modify the constant in the Blasius-Howarth equation for diffusion layer thickness, as employed to calculate l.c.d. at concentrations along the flow path. A computer program has been developed to obtain computed concentrations on the diluate and concentrate sides of anion or cation exchange membranes, and to predict voltage drops across the membrane along the flow path. Treating the transport numbers as variables extends the calculations into the acid-base generation region when the l.c.d. is exceeded.
W83-02731

CHARACTERIZATION OF FOULING POTENTIAL FOR PRESSURE-DRIVEN MEMBRANE PROCESSES: A NEW SIMULATED FLOW CELL,
Rensselaer Polytechnic Inst., Troy, NY.
R. H. Reed, and G. Belfort.
Water Science and Technology, Vol 14, No 6/7, p 499-522, 1982. 9 Fig, 4 Tab, 41 Ref.

Descriptors: *Membrane processes, *Model studies, Flow measurement, *Fouling, *Membranes, Demineralization, *Desalination, Delsalination apparatus, Reynolds number.

A new Simulated Flow Cell has been successfully tested both in the laboratory and in the field. The SFC design has the following advantages. The axial flow across the membrane surface can be varied from a Reynolds number of zero to about 6000, thus simulating flow conditions in membrane modules. All flow regimes, laminar, transitional and turbulent, can be modelled using the SFC. The SFC, operated with 30 psig center pressure, can be used under the same conditions as the Non-Flow-Cell (NFC) has been in the past. The SFC is simple to use and can predict the benefits of axial flow. The low pressure operating range allows the SFC to be constructed of plastic instead of expensive stainless steel. The SFC produced the same plugging as the NFC when both units were operated under the same conditions. The Nuclepore membranes were extremely sensitive to fouling, especially the smaller pore sized membranes. The 0.1 micron Nuclepore membrane proved to be the best choice for flow studies using PSL shears. Pressure drop measurements indicated that the SFC had laminar flow up to a Reynolds number of about 1500 and was in fully turbulent flow by a Reynolds number of about 2500. Specific cake resitance decreased with increasing Reynolds number, reaching a relatively constant value at about Re 1500 to 2000. (Baker-FRC)
W83-02745

DESALINATION BY CONTINUOUS ION EXCHANGE BASED ON THERMALLY REGENERABLE MAGNETIC MICRORESINS,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
B. A. Bolto, E. A. Swinton, P. R. Nadebaum, and R. W. Murtagh.
Water Science and Technology, Vol 14, No 6/7, p 523-534, 1982. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Desalination, Water resources development, Water supply, *Ion exchange, *Resins, *Microresins, Demineralization, Thermal regeneration, *Australia.

This paper describes the unique hydrodynamic and kinetic properties of 'Sirotherm' thermally regenerable desalting resins when made in the form of magnetic microbeads and the development of continuous contacting systems which exploit these properties. A novel multistage contactor has been evaluated on laboratory and pilot plant scales. A prototype plant with a throughput of 1 ML/day is to be installed near Perth, Western Australia,in order to demonstrate the process. It is truly continuous, simple and economic and does not require preclarification of the raw water. Various experiments were conducted with the system which indicated that reducing particle size of the resins increased the rate of reactions. For resins with fast kinetics, film diffusion was usually the controlling factor. However, if the hydrodynamic conditions could be made so turbulent that liquid film resistance was lowered, then intraparticle diffusion became the controlling factor and an even greater benefit could be derived from particle size, inversely proportional to the square of the diameter. The effects of magnetic properties on the handling characteristics of small particles are also discussed. (Baker-FRC)
W83-02748

CONTINUOUS COUNTERCURRENT ION EXCHANGE FOR DESALINATION AND TERTIARY TREATMENT OF EFFLUENTS AND OTHER BRACKISH WATERS,
Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
B. A. Hendry.
Water Science and Technology, Vol 14, No 6/7, p 535-552, 1982. 5 Fig, 6 Tab, 3 Ref.

Descriptors: *Ion exchange, *Desalination, *Tertiary water treatment, *Brackish waters, Water treatment, *Demineralization, Resins, Continuous countercurrent ion exchange.

A continuous countercurrent ion exchange (CCIX) process has been developed for desalination of mineralized effluents and other brackish waters. The process uses macroporous resins in a strong cation/weak anion sequence. Removal of organic matter by the anion resin results in color and odor removal and about 70% reduction of the chemical oxygen demand of humus tank effluent. No pretreatment is needed, and the resin has been in use over the equivalent of more than two years of continuous operation without significant fouling or loss of capacity. Any required degree of desalination is attainable. The basic four column system of coutercurrent fluidized bed multistage contactors attains greater than 80% water recovery using up to 1.0 N sulfuric acid and 0.2N lime slurry as regenerants. Calcium content of feedwater affects water recovery. The capital cost estimate for a 10,000 kl/day plant is R5 million, while unit costs of water are 30 to 40 c/kl for removal of 500 mg/l TDS. Present work involves lime contacting improvements and evaluation of carbon adsorption polishing of the ion exchange product to produce potable water. (Baker-FRC)
W83-02792

3B. Water Yield Improvement

STORING MONSOON RAINFALL IN INDIAN RESERVOIRS,
Indian Inst. of Tropical Meteorology, Poona. Hydromet Research Div.
O. N. Dhar, P. R. Rakhecha, and B. N. Mandal.
International Water Power and Dam Construction, Vol 34, No 6, p 26-29, June, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water resources development, *Water supply development, *Reservoir storage, *Storage reservoirs, *Monsoons, *India, *Storage capacity, Reservoirs, Water storage, Dams, Rainfall, Surface runoff, Runoff volume.

In Inida, a growing population and expansions in agriculture and industry have made development of available water resources a high priority item. Water from the monsoons which occur from June to September provides sufficient supplies for these needs, but new storage reservoirs are needed to fully utilize these resources. Present available storage is able to contain only about 20% of the usable flow. Assuming that only 50% of the monsoon rainfall becomes runoff, and using the known maximum storage capacity of certain reservoirs, the additional unused rainfall percentages for the major dams on monsoon-fed rivers in India were calculated. Results showed that about 92% of monsoon rainfall remains unused. It is only in a few river basins such as the Mahi, Hasedo and Chambal that about 70 to 75% of monsoon rainfall is used. In most dams, only 5 to 15% of the total monsoon rainfall is stored. The development of reservoir storage of monsoon runoff will help protect against flooding as well as provide water for irrigation and energy generation. (Geiger-FRC)
W83-02571

FEASIBILITY OF INCREASING WATER SUPPLIES AND PREVENTING ENVIRONMENTAL DAMAGE BY ARTIFICIAL RECHARGE IN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
W. S. Motts, K. O'Brien, S. Walen, and D. Haines.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191833, Price codes: A12 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 132, Massuchusetts University, Amherst, January 1983. 251 p, 45 Fig, 11 Tab, 62 Ref, 1 Append. OWRT B-067-MASS(1), 14-34-0001-9076.

Descriptors: *Artificial recharge, Groundwater, *Groundwater recharge, Seepage, Boundary processes, Artesian basins, Municipal water, *Water supply development, Potable water, *Massachusetts.

Successively more detailed first, second and third-level approximation methods show that artificial

recharge (AR) is a viable, cost effective and environmentally advantageous method for many localities in Massachusetts. First-level approximation (overview) methods indicate highly or potentially favorable AR conditions adjacent to 52.8% of the 650 municipal wells which occur in 126 (or 38.3%) of 329 state towns. Furthermore, 41.6% of the towns now without municipal wells could have future AR potential if groundwater supplies are developed. The second-level approximation method, a basin-wide study of the Ipswich Basin, showed favorable AR conditions in the towns of Danvers, Middleton, and Ispwich. Detailed third-level approximation studies showed favorable AR conditions in Amherst, Holden, Pittsfield, and Fairhaven. All water development plans including AR should be designed to obtain a water supply with lowest economic and environmental cost. The following plan for a typical Massachusetts community proceeds through successively more costly alternatives: (1) conservation and/or analysis of distribution and storage systems, (2) groundwater, (3) artificial recharge and water salvage, (4) development and treatment of ferromanganese water, (5) as a last resort more expensive alternatives including surface water reservoirs, water diversion, and tertiary treatment of contaminated sources.
W83-02728

THE HUNDRED-YEAR EFFORT TO SECURE HONG KONG'S WATER SUPPLY (HUNDERT-JAHRIGES BEMUHEN UM HONG KONG'S WASSERVERSORGUNG),
H. Lindner.
Wasserwirtschaft, Vol 71, No 5, p 146-147, May 1981 3 Fig, 1 Ref. (No English Summmary).

Descriptors: *Water supply development, *Water scarcity, Water importing, *Reservoirs, *Catchment areas, Catchment basins, *Hong Kong, Reservoir construction, Water demand, China, Water resources development, Water supply, Desalination plants, History.

The history of the development of Hong Kong's water supply is described. The main problem of water procurement is that Hong Kong is a small region of dense population with few natural catchment areas. Catchment areas have been produced by means of collection basins on mountainsides, where the water otherwise flow quickly and directly into the sea or into valleys unsuitable for reservoir construction. However, the last two major projects have abandoned this practice in favor of an underground tunnel and shaft system with a total length of 225 km to avoid further disfigurement of the landscape and the danger of landslides. The water supply system consists of 2 reservoirs in the sea, 16 conventional reservoirs, one of the world's largest desalination plants (181,800 cu m/day throughput), 14 water treatment plants, and approximately one-third (350 sq km) of its landmass used as a catchment area. Water procurement began in 1860 with the first waterworks in Victoria City and the first reservoir. The first water treatment facility became operational in 1889, and many reservoirs were constructed during the ensuing 60 years. However, until 1967, a restricted water supply was the rule rather than the exception. The first ocean reservoir was built at Plover Cove in the New Territories in the 1960s by dredging, damming, and emptying an inlet; its original capacity was 170 million cu m, expanded to 230 million cu m in 1973. In 1971, the narrows between High Island and the Sai Kung Peninsula were dammed at either end to form a reservoir with a capacity of 273 million cu m. To supplement its own supply, Hong Kong imports water from China. The first contract was signed in 1960 for 22.73 million cu m/yr, while a 1980 contract was signed for an average yearly increase of 35 million cu m from 1983 over the present 182 million cu m/yr. In 1980, China covered more than one-third of the total supply of about 1.3 million cu m/day. The demand is estimated to be 1,022 cu m/yr by 1995. (Gish-FRC)
W83-02762

3C. Use Of Water Of Impaired Quality

MAXIMIZING AQUACULTURAL POTENTIAL IN MUNICIPAL WASTEWATER PONDS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. L. King, and C. N. Spencer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190660, Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research Publication No B-052, Michigan State Univ., East Lansing, February 1983. 38 p, 12 Fig, 41 Ref. OWRT B-052-MICH(1), 14-31-0001-9077.

Descriptors: Fish, Bass, Fathead minnows, Sticklebacks, Aquatic plants, *Wastewater treatment ponds, Nutrients, *Zooplankton, *Cladoceran, *Periphyton, *Aquaculture, *Michigan, *Aquatic plant control.

Factors controlling the composition and growth of aquatic plants were investigated in four wastewater treatment ponds in southern Michigan. These ponds contained various densities of predatory fish (largemouth bass) and planktivorous fish (fathead minnows and brook sticklebacks) as well as different nutrient concentrations. Ponds developed either of two dominant plant communities in respone to predation and grazing pressures. In ponds with high densities of planktivorous fish, intense fish predation kept cladoceran zooplankton densities low and phytoplankton formed the dominant plant community. Ponds with low planktivorous fish densities maintained much higher cladoceran densities which effectively grazed the phytoplankton. Macrophytes and periphyton dominated these ponds. Growth limitation and seasonal succession within the dominant plant community were largely controlled by a combination of chemical and physical factors including depletion of inorganic nitrogen and carbon dioxide, and changes in light availability and temperature. With their significant dynamic instability, wastewater ponds in northern climates offer little opportunity for aquaculture of either fish or plants and any attempt at aquaculture will tend to compromise the wastewater treatment capacity of the pond.
W83-02485

SEASONAL VARIATIONS IN SALT AND WATER-CONTENT PROFILES IN SHALLOW AND SALINE GROUNDWATER-TABLE,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Gupta, and B. K. Khosla.
Indian Journal of Agricultural Sciences, Vol 52, No 8, p 506-510, August, 1982. 3 Fig, 11 Ref.

Descriptors: *Seasonal variation, *Soil water table, *Crop production, *Groundwater, *Surface-groundwater relations, Leaching, Soil water, Water table, Agronomy, Salt tolerance, *India.

The trends in seasonal variations in salt and water-content distribution resulting from the occurence of a shallow, saline groundwater-table and its effects on cropping conditions were studied from July 1978 to July 1979 at a typical site in the Sonepat district of Haryana, India. When most of the rains occurred in July and August, the water-table remained close to the soil surface. The removal of salt by rains was followed by a dominant upward flux, resulting in the accumulation of salts in surface layers. Salinization contained through winter and was accentuated in summer due to high evaporative demand. The electrical conductivity of groundwater also increased in summer. Some of these existing conditions can be utilized by impounding rainwater for leaching of salts during the rainy season, and growing salt-tolerant crops during the rainy season, and barley, wheat and colza during winter. Fields may also be kept fallow during the rainy season and then planted with short-duration crops. (Geiger-FRC)
W83-02573

AGRICULTURAL USE OF SUGAR REFINERY WASTEWATER CHANGE IN MINERAL NITROGEN IN SOILS USED FOR LANDSPREADING (VALORISATION AGRICOLE DES EFFLUENTS EN SUCRERIE, ETUDE DE L' EVOLUTION DE L' AZOTE MINERAL DANS LES SOLS SOUMIS AUX EPANDAGES),
BURGEAP S.A., Paris (France).
B. Guerin, and F. Heitz.
Industries Alimentaires Agricoles, Vol 99, No 3, p 133-145, March, 1982. 2 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater disposal, *Land disposal, *Nitrogen, Percolation, Infiltration, Leaching, Corn, Crop yield, Irrigation, Fate of pollutants.

During two waste-water land-spreading seasons using flume water experimental data have been gathered. The water charge fluctuated between 120 and 150 mm with every campaign. Nitrogen percolation was observed through a thick loamy non-hydromorphic soil in the north-west of France. Spreading on stubble, previously plowed in large furrows, did not initiate any discernible nitrate percolation, even when a large amount was present in the ground. An intercalary crop, preceding the spreading, did not give any additional advantage in restricting nitrate percolation. Nitrogen introduced with waste water is very incompletely and very slowly nitrified, and was ultimately available for the following crop (corn). Nitrogen fertilizer was partially used and satisfied the early needs of the plant. Prolonged nitrate release will continue to the second following crop. Nitrogen balance between spreading input an cropping out should be computed over two cultivation years with the intention of reducing it. (Baker-FRC)
W83-02633

3D. Conservation In Domestic and Municipal Use

THE EFFECTS OF WATER CONSERVATION ON NEW WATER SUPPLY FOR URBAN COLORADO UTILITIES,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
C. Ellinghouse, and G. McCoy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-189951, Price codes: A08 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report No 120, Colorado State University, Fort Collins, December 1982. 146 p, 10 Fig, 41 Tab, 23 Ref, 7 Append. OWRT A-049-COLO(1), 14-34-0001-1106.

Descriptors: Conservation, *Water conservation, *Water use efficiency, *Water supply, Water law, Water transfer, Legal aspects, *Water costs, Value, *Water policy, *Colorado, *Utilities, Comparative costs.

A model is developed and used with various scenarios to make a comparison of the costs and benefits of a water conservation program for various sizes and types of Colorado cities. Colorado water law and the scarcity of water encourages cities to acquire more water than they need and to resist conservation because of implied threats that they may lose water they are not currently using. Based on surveys of selected cities, costs of water acquisition from transfers, storage, imports and purchase are evaluated and projected into the future. These costs are compared with the costs of various conservation programs that will modify demand and thus reduce need for additional water. The results of this study show that for all types of cities and all growth rates conservation is the more economic approach to be utilized for urban utilities in Colorado.
W83-02500

AN EVALUTION FRAMEWORK FOR ASSESSING VARIATIONS IN THE COSTS AND BENEFITS OF MUNICIPAL WATER CONSERVATION,
INTASA, Inc., Menlo Park, CA.
For primary bibliographic entry see Field 6B.
W83-02743

3E. Conservation In Industry

URGENT PROBLEMS OF CONSERVATION AND RATIONAL USE OF WATER RESOURCES,
For primary bibliographic entry see Field 5G.
W83-02623

EVALUATION OF BIOLOGICAL ACTIVATED CARBON INDUSTRIAL WATER REUSE,
Jacobs Engineering Group, Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W83-02742

3F. Conservation In Agriculture

THE ECONOMIC IMPACTS OF ALTERNATIVES AND CONTINGENCIES RELATING TO THE 1978 DECISIONS OF THE MONTANA BOARD OF NATURAL RESOURCES ON WATER RESERVATIONS IN THE YELLOWSTONE BASIN,
For primary bibliographic entry see Field 6B.
W83-02493

ANALYSIS OF IRRIGATION PUMPING AND APPLICATION EFFICIENCY IN NEVADA,
Max C. Fleischmann Coll. of Agriculture, Reno, NV. Div. of Agricultural Economics.
T. R. Harris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186528, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center, Desert Research Institute Publication No 43010, Univ. of Nevada, Reno, February 1983. 67 p, 17 Tab, 6 Fig, 39 Ref. OWRT A-104-NEV(1), 14-34-0001-2130.

Descriptors: *Nevada, *Alfalfa, Irrigation, Production function, *Irrigation delivery efficiency, Pumping plant efficiency, Alfalfa plant growth model, Irrigation cost generator, *Irrigation strategies, Pumping, Irrigation practices.

Irrigated alfalfa production in Nevada is a major segment of the state's agricultural sector. However, with increasing fuel costs and variable surface water supplies, efficient allocation of water is desired. Determination of profit maximizing quantities of water for Central Nevada under different irrigation delivery and pumping efficiencies were derived. A computer irrigation cost generator from Oklahoma State University was put on the University of Nevada's main frame computer to derive irrigation costs for different electrical charges, water delivery efficiencies, and pumping efficiencies. The study indicates a potential for substantial water and cost savings with improved water delivery and pumping plant efficiencies. Also, soil moisture and alfalfa plant growth relationships were derived through an alfalfa plant growth model from Utah State. The alfalfa plant growth model was put on the main frame computer and verification of the model was performed for a surface water delivery system in Fallon, and a center pivot and surface water delivery system in Diamond Valley, Nevada. After verification, different irrigation strategies were developed for the surface delivery system in Diamond Valley. The irrigation strategy that may be a viable alternative to contemporary practices is to irrigate up to the first cutting and discontinue irrigation for that season.
W83-02499

DRIP IRRIGATION SAVES MONEY IN YOUNG ALMOND ORCHARDS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
E. Fereres, J. R. Castel, D. A. Martinich, E. Holzapfel, and T. M. Aldrich.
California Agriculture, Vol 36, No 9/10, p 12-13, September/October, 1982. 1 Fig, 2 Tab.

Descriptors: *Drip irrigation, *Water conservation, *Irrigation engineering, Irrigation efficiency, Water supply, Irrigation, Evapotranspiration, Evaporation, *Almond orchards, *California, Arbuckle.

A four year evapotranspiration (ET) experiment was conducted in a 40 acre orchard of drip-irrigated young almond trees at the Nickels Soils Laboratory, near Arbuckle, Colusa County. The trees were 3 years old at the start of the study and were irrigated by two micro-tube emitters per tree. The soil, an Arbuckle gravelly sandy loam over a gravelly clay substratum, has low water storage capacity. Young trees that shaded less than 10% of their area at midsummer had more than 20% of the estimated ET of a mature orchard. By the time the six-year-old trees shaded around 42%, their ET was between 85 and 88% of the ET of a mature orchard. The ET of any crop is directly related to the available energy and to the aerodynamic conditions that prevail in the area. For young trees irrigated by drip, where the soil is partially wetted and the tree canopy shades only a fraction of the total area, horizontal energy transfer (advection) from the dry areas surrounding the trees must increase the transpiration rate above that of canopies where the whole soil surface is frequently wetted by rain or irrigation. The water savings potential of drip irrigation is maximum for the first two years of the orchard, then declines as trees grow, and probably becomes very limited after the sixth year. (Baker-FRC)
W83-02521

BORON CONCENTRATION IN THE SOIL SOLUTION UNDER IRRIGATION: A THEORETICAL ANALYSIS,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 2K.
W83-02574

COTTON GROWTH RELATED TO PLANT'S WATER STATUS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. W. Grimes, and H. Yamada.
California Agriculture, Vol 36, No 11/12, p 13-14, November/December, 1982. 4 Fig.

Descriptors: *Water availability, *Irrigation practices, *Moisture stress, *Cotton, *Plant growth, Plant yield, Irrigation, Water supply, Moisture availability, Soils, Soil types, Leaf water potential.

Cotton irrigation scheduling varies greatly in arid and semiarid regions, where large differences occur in soil water retention and transmission properties. Since the plant reflects its total environment, a measurement on the plant to determine its water status will sometimes be a better indication of when irrigation is needed than soil water. The water status, or leaf water potential, of vascular plants can be measured with a pressure chamber. Primary features of the apparatus include the pressure chamber, gauge, and control valve, and a small nitrogen gas tank that provides the pressure. A three year field study was conducted on cotton in the San Joaquin Valley. The tests were on Panocheclay loam and on Wasco sandy loam. Changes in leaf water potential over time for contrasting soils were examined to evaluate the usefulness of this measurement for scheduling irrigations. Treatments that varied timing of the first irrigation of the growing season showed best results when leaf water potential was allowed to decline to about -16 bars just before the irrigation. This degree of stress slowed growth slightly. After substantial root extension and plant conditioning, yields were optimum when midseason irrigations were scheduled at midday leaf water potentials of -18 to -20 bars. At peak bloom results may be improved by irrigation at -18 bars, since the plant is more sensitive to yield loss from excessive stress at this stage. (Baker-FRC)
W83-02576

THE ADAPTATION OF VARIETIES OF SORGHUM TO DIFFERENT WATER REGIMES,
Institut National de Recherches Agronomiques au Niger, Niamey.
For primary bibliographic entry see Field 2I.
W83-02612

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A MODEL FOR DRAINAGE BENEFITS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
W. D. Lembke, C. J. W. Drablos, J. G. Arnold, and J. N. Scarborough.
Transactions of the ASAE, Vol 25, No 5, p 1329-1332, September/October, 1982. 6 Tab, 15 Ref.

Descriptors: *Drainage, *Model studies, *Crop yield, Runoff, Rainfall-runoff relationships, Farming, *Illinois, Soil properties.

A regression model for corn yield was developed which includes rainfall during two critical periods of the growing season: the time during which spring tillage and planting occurs, and the time during which pollination occurs. The regression model was applied to three widely different situations: eight counties in Illinois that could be grouped according to soil associations with relatively similar drainage problems; three University of Illinois farms in close proximity but with different levels of drainage; and drainage research plots at the University of Illinois Brownstone Research Center. Rainfall during period 1 was found to significantly affect yields on farms with inadequate drainage systems. The model has the potential to be useful in explaining yield differences between well drained and poorly drained farms. (Baker-FRC)
W83-02452

DRAINAGE COEFFICIENTS,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
L. S. Willardson.
Transactions of the ASAE, Vol 25, No 5, p 1251-1253, 1257, September/October, 1982. 1 Fig, 14 Ref.

Descriptors: *Drainage coefficient, *Mathematical equations, *Soil water, Arid regions, Humidity, Water table, Drain spacing, Drainage, Drainage patterns.

Drainage coefficients used in humid and arid regions were developed by different methods. The procedure by which the data are handled and the design equation used, steady state or transient, can affect calculated drain spacing. A tensor product Lagrange interpolant is presented that can be used to adjust design water table heights to get equivalent drain spacings using either design method. Drainage coefficients as currently determined can be used without special adjustments. (Baker-FRC)
W83-02454

LAND-USE AND MANAGEMENT PROBLEMS IN THE NILE DELTA,
Ministry of Irrigation, Cairo (Egypt). Research Inst. for Groundwater.
For primary bibliographic entry see Field 6G.
W83-02462

HYDROBIOLOGICAL CONDITIONS IN THE KARAKUMY CANAL,
Akademiya Nauk Turkmenskoi SSR, Ashkhabad. Inst. Botaniki.
Sh. I. Kogan, Yu. Ye. Lyubeznov, Kh. S. Sadykov, M. A. Kemzhayev, and A. P. Gaipova.
Hydrobiological Journal, Vol 17, No 6, p 9-18, 1981. 3 Fig, 7 Tab, 34 Ref.

Descriptors: Water quality, *Canals, *Vegetation, Turbidity, Plant growth, *Hydrobiology, Eutrophication, Biomass, Phytoplankton, Macrophytes, Algal growth, *USSR, Karakumy Canal.

The Karakumy canal is a prototype of a long, high-throughput waterway, diverting water from

Siberian rivers to and through desert regions. Data on its hydrology, chemistry and vegetation 25 years after opening of the first section are presented, concentrating on the effects of plant life on water quality and canal operation. One of the factors which has a very strong effect on the hydrobiology of the canal is its high turbidity. The chemical composition of the canal water depends on the conditions in the Amu Dar'ya, the operating conditions, and low salt concentrations in the summer. In the first years of its operation, some sections of the canal were strongly overgrown. Now, however, 15 years later, submerged vegetation is sparse because of the high turbidity. The presence of reed thickets in the canal has improved water quality both directly as biofilters and indirectly by anchoring the banks. In predicting the development of macrophytes and algae in the canal the tendency toward eutrophication of the canal as a whole must be considered, along with the fact that in the near future clarified water will enter the canal. (Baker-FRC)
W83-02625

COME HELL AND HIGH WATER: MT. ST. HELENS AND THE FEDERAL RESPONSE ON THE LOWER COWLITZ RIVER,
Central Washington Univ., Ellensburg. Dept. of History.
G. H. Warren, D. E. Kaufman, and K. A. Hammond.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191791, Price codes: A12 in paper copy, A01 in microfiche. Completion Report, December 1982. 213 p, 28 Fig, 110 Ref, 8 Append. OWRT C-10130-V(1476)(1), OWRT 14-34-0001-1476.

Descriptors: *Economic aspects, *Environmental effects, *Flood control, *Historic floods, *Social impact, *Volcanoes, Agriculture, Dredge spoil, Ecological effects, Economic development, Flood frequency, Rivers, Social adjustment, Social costs, *Washington, *Cowlitz River, *History, Mt. St. Helens.

Pioneers relied on the Cowlitz River for transportation but 20th Century residents value it for irrigation, recreation, and industrial uses. The federal government early assumed responsibility for channel maintenance, then flood control, and is now involved in both efforts. Periodic floods have not had long-term economic effects but temporarily slowed retail sales and construction. The 1980 Mt. St. Helens eruption is a continuing disaster which caused severe short-term damages and might have long-term economic and psychological impacts. Questionnaires were mailed in February, 1982, to 192 property owners who participated in the lower Cowlitz River restorative program, and a 20% sampling of those who responded were telephoned in a follow-up survey in July, 1982. Over 60% of the property owners lived elsewhere, believed they were the primary benefactors of the dredging operation, and welcomed additional spoils. Residents were most concerned about the spoils' infertility and the loss of recreation on the river. Field observations, information from governmental agencies, and interviews lead to the conclusions that: (1) the mudflow and spoils have low agricultural potential; (2) some owners reaped windfall benefits from the dredging program; and (3) some form of program to protect the area from future flooding will be demanded and will involve structures rather than social adjustments.
W83-02724

PLANT-SUBSTRATE INTERACTIONS AND BELOW SUBSTRATE BIOMAS DYNAMICS: A CONTINUATION OF STUDIES CONCERNING POTENTIAL RESTRICTION OF THE INTRODUCED AQUATIC WEED MYRIOPHYLLUM , SPICATUM L. (EURASIAN WATER MILFOIL),
Tennessee Univ., Knoxville. Dept. of Ecology.
For primary bibliographic entry see Field 2I.
W83-02729

4B. Groundwater Management

SYMPOSIUM ON SURFACE COAL MINING AND RECLAMATION IN THE NORTHERN GREAT PLAINS, AN UPDATE ON MINE SPOILS HYDROLOGY SOUTHEASTERN MONTANA,
Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 2F.
W83-02495

DISTURBANCE OF WATER PURIFICATION PROCESS BY ALGAE, ESPECIALLY DURING THE INFILTRATION OF A BIOLOGICALLY ACTIVE SURFACE WATER (BEEINTRACHTIGUNG DER WASSERREINIGUNG, INSBESONDERE BEI DER INFILTRATION EINES BIOLOGISCH HOCHAKTIVEN OBERFLACHENWASSERS),
Dortmunder Stadtwerke A.G. (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W83-02717

PRELIMINARY ASSESSMENT OF GROUND WATER MANAGEMENT ALTERNATIVES FOR IDAHO,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
D. R. Ralston, S. duPont, and K. Hampton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191817, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, December 1982. 38 p, 9 Fig, 2 Tab, 8 Ref. OWRT A-078-IDA(1), 14-34-0001-0216.

Descriptors: *Groundwater management, *Groundwater mining, Groundwater budget, Groundwater depletion, *Idaho, *Alternative planning, Pumping rates, *Groundwater depletion, Recharge.

Many if not most of Idaho's ground water basins may be presently pumped at rates that exceed natural recharge. The general objective of this project is to provide a preliminary assessment of alternative management schemes for problems of overdraft of ground water basins. Four study basins were selected to represent the range of ground water development problems and the various stages of present resource management. Ground water development in the Moscow Basin has resulted in a steady rate of water level decline in what is likely a 'mining' situation. Local areas of water level decline have resulted from recent development of ground water in the Mountain Home area. A portion of this area is the Camas Praire area as a result of changing from dry land to irrigated agriculture. The Raft River Basin was declared critical in 1963. Management factors have been divided into three groups: hydrologic, development and legal guidelines. A basin classification system has been presented as a first step in a statewide management program. The classification system includes four factors reflecting management factors.
W83-02726

FEASIBILITY OF INCREASING WATER SUPPLIES AND PREVENTING ENVIRONMENTAL DAMAGE BY ARTIFICIAL RECHARGE IN MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Geology and Geography.
For primary bibliographic entry see Field 3B.
W83-02728

4C. Effects On Water Of Man's Non-Water Activities

SEDCON: A MODEL OF NUTRIENT AND HEAVY METAL LOSSES IN SUSPENDED SEDIMENT,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 2J.
W83-02734

4D. Watershed Protection

MASS BANK FAILURE ANALYSIS OF SELECTED YAZOO BASIN STREAMS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
W. C. Little, C. R. Thorne, and J. B. Murphey.
Transactions of the ASAE, Vol 25, No 5, p 1321-1328, September/October, 1982. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Streams, *Erosion control, *Banks, Channels, Erosion, Flow, Alluvial deposits, Borehole Shear Tester, Soil properties, Soil strength, *Yazoo Basin, River basins, *Mississippi.

The Iowa Borehole Shear Tester was used to measure in situ soil strength properties of loess-derived alluvial deposits. A simple stability analysis procedure and the measured soil properties were used to determine stable bank height and angle for the given soil properties for streams in the bluffline area of the Yazoo basin. Worst case conditions representing prolonged wet periods were a good predictor of critical bank height and angle. Calculated critical bank heights for the given bank angle, using the worst case conditions, agreed closely with observed bank heights and angles. Mean conditions, representing dry conditions during the summer, were an extremely poor predictor of instability. Structural toe revetments should be the most effective remedy for mass bank failures, since the revetment would decrease both the height and angle of bank and also prevent erosion of the bank toe. Results show the great importance of the control of bank height through control of channel bed degradation. The analysis may be used to aid in determining the location and invert elevation of channel grade control structures and the placement of toe revetment. (Baker-FRC)
W83-02453

MODELING SEDIMENT DEPOSITION BEHIND CORN RESIDUE,
Iowa Cooperative Extension Service, Cedar Rapids.
L. G. Brenneman, and J. M. Laflen.
Transactions of the ASAE, Vol 25, No 5, p 1245-1250, September/October, 1982. 9 Fig, 2 Tab, 17 Ref.

Descriptors: *Erosion control, *Model studies, *Slopes, Vegetation, Crops, *Corn, Rainfall, Sedimentation, Erosion, Watershed protection.

A simulation model was developed to predict the amount of sediment deposited behind corn residue in row middle areas. Data generated in a rainfall simulator field study were used for model validation. Observed soil erosion rates compared favorably with erosion rates predicted by the model. The results generated by the simulation model indicate that, although differences in soils can change crop residues' effect on soil losses, more influence is exerted by differences in slope steepness. As slope steepness increased crop residues were less effective in controlling soil erosion. (Baker-FRC)
W83-02455

GULLY CONTROL: DETERMINING TREATMENT PRIORITIES FOR GULLIES IN A NETWORK,
B. H. Heede.
Environmental Management, Vol 6, No 5, p 441-451, September, 1982. 10 Fig, 4 Tab, 10 Ref.

Descriptors: *Gullies, *Planning, *Erosion control, Erosion, Management, Watershed management, Design criteria.

A newly developed procedure for setting priorities in gully control is described. Basic gully systems and developments are explained as they are influenced by geomorphologic processes on which the proposed procedure is based. These processes con-

sist of two types; one representing interactions between the individual gullies of a network and the other, mechanisms initiated within a given gully by localized instability conditions. Classifying gullies into continuous and discontinuous types not only allows determination of network types but also points to critical locations that must be considered by the designer. The procedure consists of five steps: determining type of network based on gully types; stream ordering of the network gullies; tallying tributaries of each gully; analyzing stage of development of each gully; and ranking of treatment priorities. This technique establishes priorities that depend on opportunities to exert the greatest control for the least cost and to prevent the greatest amount of future erosion. (Baker-FRC)
W83-02544

SEDIMENT DEPOSITION IN A FLOOD-RETENTION STRUCTURE AFTER TWO RECORD FLOODS IN SOUTHWESTERN WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
P. A. Kammerer, and W. G. Batten.
Journal of Soil and Water Conservation, Vol 37, No 5, p 302-304, September/October, 1982. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Sediment transport, *Floods, *Wisconsin, Sedimentation, Flood control, Erosion, Erosion control, Drainage basins, Driftless Area, Floodwater retention, Surface runoff.

Sediment deposited in a flood-control structure was measured after record floods in southwestern Wisconsin on June 17 and June 30-July 1, 1978. The structure is in the Driftless Area, where high relief, erodible soils, and land use contribute to high soil losses. The two floods deposited 4.1 acre-feet of sediment in the structure. This translates into a sediment yield of 3,200 tons per square mile from the 2.3 square mile drainage basin. Comparison of this yield to the average annual sediment yield of 13 tons per square mile between 1968 and 1974 illustrates the importance of isolated hydrologic events in determining sediment yields in the Driftless Area. (Baker-FRC)
W83-02705

MODIFIED RUNOFF CURVE NUMBERS FOR SUGARCANE AND PINEAPPLE FIELDS IN HAWAII,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 2A.
W83-02706

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SEDIMENTARY CHARACTERISTICS OF SUSPENSIONS IN LONDON STORMWATER,
Middlesex Polytechnic, London (England).
J. B. Ellis, R. Hamilton, and A. H. Roberts.
Sedimentary Geology, Vol 33, No 2, p 147-154, 1982. 3 Fig, 17 Ref.

Descriptors: *Sediments, *Storm water, *Urban runoff, Suspended sediments, Storm runoff, London, *United Kingdom, Runoff, Particle size, Chemical composition, *Pollutant identification.

The size and composition of suspended solids in urban runoff were studied during 3 storm events in a 420 ha section of London. The particle size distribution (1-60 microns), suspended solids concentrations (maximum 262 mg per liter) rainfall intensity, and antecedent conditions varied widely among the storms. The particle size distribution showed strong bimodality (peaks at 2 and 20 microns) in the 2 summer storms. Smaller particles were dominant in the rising limb of the hydrograph because of flushing from the storm drain system early in the storm. In the third storm the unimodal distribution indicated flocculated or aggregated suspensions, which was confirmed by microscopic studies. Storm water sediments consisted of inorganic grains, organic matter, bacterial slimes, and other particles. Most particles were aggregated. Finer inorganic sediment fractions were dominated by quartz and feldspar, with smaller amounts of mica and chlorite. Little or no clay minerals were present. Chemically, the most common elements were Si and Al, followed by K, Fe, and Ca. Small amounts of Mg, S, Cl, P, and Ti were consistently found. This composition was typical of road dusts. Coarse sediments were rapidly transported through the system, as evidenced by the unaltered physical and chemical natures. (Cassar-FRC)
W83-02451

DETECTION OF POTENTIAL CARCINOGENS AND TOXICANTS IN TAP AND RECLAIMED WATER BY THE GOLDEN HAMSTER CELL TRANSFORMATION ASSAY,
National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, and O. W. Prozesky.
Water Research, Vol 16, No 12, p 1561-1568, December, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Carcinogens, *Reclaimed water, *Secondary wastewater treatment, Pollutant identification, Toxicity, Water analysis, Wastewater treatment, Fate of pollutants, Water treatment, Transformation assay, Hamster cells, Bioassays.

A transformation assay using primary golden hamster embryonic cells was used to detect carcinogens in samples of Stander reclamation plant influent, effluent, and process streams. The average percentages of transformation of various water samples were: influent, 0.80%; effluent, 0.16%; and tap water, 0.36%. Transformation percentages in intermediate process steps showed a gradual reduction except in three instances. Toxocity was also reduced by the reclamation process: influent, 58% survival of cells, and effluent, 76% survival of cells. Variations in water quality parameters were not correlated with changes in transformations or toxicity levels. This method required no concentration or extraction procedures. (Cassar-FRC)
W83-02460

PESTICIDES IN LOWER FLATHEAD VALLEY DRAINAGE,
Montana Univ., Missoula. Dept. of Environmental Studies.
R. E. Erickson, and M. G. Essig.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186494, Price codes: A02 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 123, Montana State Univ., Bozeman, September 1981. 23 p, 1 Fig, 2 Tab, 4 Ref, 1 Append. OWRT A-121-MONT(1), 14-34-0001-0128, 14-34-0001-1128.

Descriptors: Baseline studies, Water quality, *Pesticide residue, Gas chromatography, *Pollutant identification, Sampling, Pesticides, Water analysis, Instrumentation, Lower flathead drainage, *Montana.

Samples of stream water from six sites in the lower Flathead River drainage were analyzed for selected pesticides (2,4D, 2,4D methyl ester, xylenes, diazinon, endosulfan, monitor, banvel, and perthane) over an eleven-month period in 1980. None of the sampling sites showed any trace of any of the target pesticides on any of the 14 sampling days of the study. (Detection limits were between .04 and .25 ppm for all pesticides except xylenes, whose detection limit was 5 ppm). Although the study was beset with instrument problems from its inception, a cross-check of a randomly selected set of samples using a more reliable gas chromatorgraph with a flame ionization detector validated these results.
W83-02496

ISOLATION OF HYDROCARBON RESIDUES FROM SEDIMENT BY STEAM DISTILLATION,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
A. A. Belisle, and M. L. Gay.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 5, p 539-543, November, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Separation techniques, *Hydrocarbons, *Stream pollution, *Bottom sediments, Oil, *Pollutant identification, Cleanup, Gas chromatography, Mass spectrometry, Pennsylvania, *Steam distillation method.

A quick and efficient cleanup procedure utilizing steam distillation was developed for the isolation of hydrocarbons in wet sediments before residue analysis by gas chromatography-mass spectrometry. The method involves extraction and cleanup of sediment in a modified Nielson-Kryger steam distillation apparatus for 2 hr. The procedure was tested on sediment samples from a western Pennsylvania stream, which were spiked at levels of 0.04 and 4.0 parts per million (ppm) with each of 14 aliphatic and 9 aromatic petroleum hydrocarbons known to accumulate in animal tissue. The absolute detection limit was about 0.50 nanograms for all compounds, and recoveries of the reference hydrocarbons ranged from 33 to 100% when spiked at 0.04 ppm and from 72 to 93% at 4.0 ppm. Results indicate that steam distillation offers a relatively simple and efficient method for extraction of aliphatic and aromatic hydrocarbons in wet sediment. (Geiger-FRC)
W83-02514

THE OCCURRENCE OF PCH3-CONTAINING COMPOUNDS IN SURFACE WATERS,
Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research.
A. Verweij, G. F. Mensingh, and H. L. Boter.
Chemosphere, Vol 11, No 10, p 985-990, 1982. 5 Tab, 3 Ref.

Descriptors: *Surface waters, *Water pollution sources, *Organic compounds, Industrial wastes, Wastewater, Pollutants, Methylphosphonates, Fate of pollutants, *PCH3 compounds, Pollutant identification.

The concentration of PCH3 (methylphosphonate)-containing compounds was determined in several surface water samples obtained from a number of Western European countries and in North America. A correlation was found between the concentration and the degree of water pollution. This correlation suggests that the presence of PCH3-containing compounds in water is due to industrial sources of water pollutants. The samples were easily divided into four distinct groups: very clean, clean, industrially polluted, and wastewater, according to the grades of pollution as indicated by the sampling authorities. The results confirm the previously suggested possibility of methylphosphonic acid accumulation in the environment. (Baker-FRC)
W83-02518

THE EPA-TEST -- A METHOD FOR THE DETERMINATION OF PHOTOCHEMICAL DEGRADATION OF ORGANIC COMPOUNDS IN AQUATIC SYSTEMS (DER EPA-TEST--EINE METHODE ZUR BESTIMMUNG DES PHOTOCHEMISCHEN ABBAUS VON ORGANISCHEN VERBINDUNGEN IN AQUATISCHEN SYTEMEN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Freising-Weihenstephan (Germany, F.R.).
K. Hustert, M. Mansour, H. Parlar, and F. Korte.
Chemosphere, Vol 10, No 9, p 995-998, September, 1981. 2 Tab, 3 Ref. (No English Summary).

Descriptors: *Pollutant identification, *Degradation, *Solar radiation, *Organic compounds, *Water analysis, Mathematical equations, Laboratories, Testing procedures, *Photochemical degradation, Methanol, Benzene, Hexachlorobenzene, p-Nitrophenol, Hydrogen ion concentration, Geography, Seasonal variation, Weather, Carbon tetrachloride, Fate of pollutants.

A collaborative study conducted by the OECD Chemical Testing Program to test a method of analyzing the degradation of environmental chemicals in aquatic systems under the influence of sunlight is described. Five compounds were tested: methanol, carbon tetrachloride, benzene, hexachlorobenzene, and p-nitrophenol. The compounds were dissolved in water at controlled concentrations in glass test tubes, which were placed in sunlight for specified periods. Equations to calculate the rate constant and half-time of biological degradation comprised the method to be tested. No reduction in concentration due to radiation was noted for hexachlorobenzene, carbon tetrachloride, or methanol, which is understandable, as they do not absorb in the 290 nm wavelength region. Experiments with quartz glass test tubes were also negative. The longest half time was recorded for benzene (16.9 days). Since p-nitrophenol is a weak acid, half-times were dependent on the pH of the solution. Weather conditions changed in the course of the experiment, and since no actinometer was used, results can only be compared with reservation. The half-times for all substances except p-nitrophenol showed an extremely wide spread; possible causes were high volatility variable radiation intensity, or unsuitable testing methods. Results showed that the method is not suitable for all substances. Problems occurred with low water solubility and high vapor pressure. Another precondition is absorption in the 290 nm wavelength region. An actinometer should be used to monitor radiation intensity, or control substances should be employed. Standard methods of analysis are recommended for collaborative studies. Under these conditions, the EPA method is acceptable. (Gish-FRC)
W83-02519

PERSISTENT ORGANIC CHEMICALS IN SEWAGE EFFLUENTS. 2. QUANTITATIVE DETERMINATIONS OF NONYLPHENOLS AND NONYLPHENOL ETHOXYLATES BY GLASS CAPILLARY GAS CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
E. Stephanou, and W. Giger.
Environmental Science and Technology, Vol 16, No 11, p 800-805, November, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Surfactants, *Phenols, *Nonyl phenols, *Pollutant identification, Detergents, Nonionic Surfactants, Toxicity, Alkyl phenols, Organic compounds, Wastewater analysis, Path of pollutants, Gas chromatography.

Nonylphenols (NP) and nonylphenol ethoxylates with 1 and 2 oxethylene groups (NP1 and NP2) were quantitatively determined in effluents from six secondary sewage plant effluents in the Zurich, Switzerland, area. These substances, highly toxic to aquatic organisms, are refractory metabolites of the nonylphenol polyethoxylate nonionic surfactants. Nonylphenol and derivatives were not detected (limit, < 10 micrograms per liter) in effluents from three of the plants, all of which operated under low loading conditions. In the other effluents the concentrations (micrograms per liter) were: NP, non-detectable to 35; NP1, 24-133; and NP2, non-detectable to 70; totals, 36-202 or 0.5%-2.3% of total residual dissolved organic carbon. (Cassar-FRC)
W83-02529

PROTAMINE PRECIPITATION OF TWO REOVIRUS PARTICLE TYPES FROM POLLUTED WATERS,
Dugway Proving Ground, UT. Environmental and Life Science Div.
D. J. Adams, D. N. Ridinger, R. S. Spendlove, and B. B. Barnett.
Applied and Environmental Microbiology, Vol 44, No 3, p 589-596, September, 1982. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Viruses, *Water analysis, *Water pollution, Human diseases, Public health, Pollutant identification, Wastewater.

Two forms of virus particle are released from reovirus-infected cell cultures, infectious reovirus and potentially infectious reovirus (PIV). PIV particles forms have a complete outer coat and are not infectious until the outer coat is changed or removed. The PIV concentration in polluted waters, however, has not been determined. Protamine sulfate precipitation, using 0.25% fetal bovine serum and 0.005% protamine sulfate for the first precipitation of the sample and 0.0025% for the second, was employed to concentrate infectious reovirus and PIV from water and sewage. Infectious reovirus and PIV particles were concentrated over 500-fold from river water inoculated with virus, and virus recoveries of between 80 and 100% were achieved. Virus precipitates stored at -20C as a protamine-virus concentrate showed a 5% loss of PIV after 14 days. Virus preparations were assayed, before and after treatment, with 200 micrograms of chymotrypsin per ml, using a fluorescent-antibody procedure. Protamine sulfate precipitation and fluorescent-antibody detection are effective ways to recover and assay reoviruses present in raw sewage. (Baker-FRC)
W83-02555

THE ECOLOGICAL CLASSIFICATION OF THE QUALITY OF SURFACE WATERS ON LAND, PRINCIPLES AND PRACTICAL EXPERIENCE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5C.
W83-02569

PRACTICAL DETERMINATION OF THE FIRST STAGE BOD OF SEWAGE,
T. Stones.
Effluent and Water Treatment Journal, Vol 22, No 10, p 391-394, October, 1982. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Biochemical oxygen demand, *Wastewater oxidation, *Oxidation, *Wastewater treatment, Dissolved oxygen, Oxygen, Domestic wastewater, Wastewater analysis, Kinetics.

A relationship for determining first stage (carbonaceous) biochemical oxidation of a 1/100 dilution of settled domestic sewage at 20C was prepared from experimental results. The first stage BOD = dx/dt x $1/k(a - x) + x$, where k = velocity coefficient (0.039 for domestic sewage), a = initial dissolved oxygen concentration, and x = amount of dissolved oxygen absorbed. On the average, the amount of dissolved oxygen absorbed in 5 days was about 75% of the first stage BOD. (Cassar-FRC)
W83-02581

OPTIMIZATION STUDIES FOR RELIABLE TRACE METAL ANALYSIS IN SEDIMENTS BY ATOMIC ABSORPTION SPECTROMETRIC METHODS,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
R. Breder.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 313, No 5, p 395-402, 1982. 5 Fig, 13 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Atomic absorption spectrophotometry, *Analysis of variance, *Sediments, *Trace metals, *Precision, Metals, Separation techniques, Decomposition, Mathematical studies, Lake sediments, Marine sediments, Fluvial sediments, Standard deviation, *Federal Republic of Germany.

Sediments may act as permanent or temporary traps for metals introduced into the aquatic environment. Studies were performed on the total metal contents of sediment samples taken from rivers, lakes, estuaries, and coastal zones. The sediments were decomposed under pressure with a 3:1 mixture of nitric acid/hydrochloric acid and analyzed by atomic absorption spectrometry in appropriate specific modes (flame, graphite, furnace, cold vapor mode, hydride system). The methods were optimized and verified with regard to precision and accuracy for the determination of 12 metals (Ag, As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, and Zn) or metalloids with the help of some new representative Standard Reference and Control Materials. (Geiger-FRC)
W83-02609

EXTRACTIVE SPECTROPHOTOMETRIC DETERMINATION OF NITRATE IN POLLUTED WATERS,
Ravishankar Univ., Raipur (India). Dept. of Chemistry.
A. Chaube, A. K. Baveja, and V. K. Gupta.
Analytica Chimica Acta, Vol 143, p 273-276, 1982. 3 Tab, 11 Ref.

Descriptors: *Pollutant identification, *Spectrophotometry, *Nitrites, *Separation techniques, *Dyes, Water analysis, Absorption, Sensitivity analysis, Industrial wastes, Nitrogen compounds, Rivers.

A highly sensitive method was developed for the extractive spectrophotometric determination of nitrate at the parts per billion (ppb) level using p-nitroaniline as diazotization reagent and 8-quinolinol as coupling reagent. Nitrite in water samples is diazotized with p-nitroaniline in hydrochloric acid and coupled with 8-quinolinol in alkaline medium to give a purple azo dye. Extraction of the dye into 3-methyl-1-butanol shifts the absorption maximum to 570 nanometers, thus improving the apparent molar absorptivity to .0005852 liters/mole/cm while masking the effects of interfering ions. The Sandell sensitivity of the method is 0.00078 micrograms/sq cm, and Beer's law is obeyed for 0.01-0.06 ppm nitrite. The method was successfully applied to analysis of nitrite in polluted river water samples and proved more selective than conventional sulfanilamide-N(1-naphthyl)-ethylenediamine dihydrochloride methods of nitrate determination. (Geiger-FRC)
W83-02635

THE DETERMINATION OF LEAD IN TAPWATER BY RESIN PRECONCENTRATION FOLLOWED BY FLAME ATOMIC ABSORPTION SPECTROMETRY,
Edinburgh Univ. (Scotland). Dept. of Chemistry.
A. G. Rowley, I. A. Law, and F. M. Husband.
Analytica Chimica Acta, Vol 143, p 265-268, 1982. 5 Ref.

Descriptors: *Lead, *Separation techniques, *Atomic absorption spectrophotometry, *Resins, *Polymers, Potable water, Adsorption, *Pollutant identification, Water analysis, Sample preparation.

A simple and economical method for the preconcentration of lead from tapwater based on a resin of polystyrene-supported poly(maleic anhydride) was developed. The preconcentration sample is analyzed by flame atomic absorption spectrometry at 217 nm. The resin is prepared by initiating the polymerization of maleic anhydride by polystyryl(ethylpyridine) under nitrogen at 120 degrees for 5 hr. The resin beads are held by glass wool in a vertical tube of flexible polyvinyl chloride, 8 mm internal diameter. Adsorption of lead from a one-liter tap water specimen passing through 1 g of resin under natural gravity flow in 1 hr was quantitative. Dilute (2 molar) nitric acid serves as eluant. The method was found to be accepatable for the determination of lead at levels well below the 50 nanogram/cu cm limit proposed by the Council of European Communities. (Geiger-FRC)
W83-02636

THE POTENTIOMETRIC TITRATION OF SULFIDE IN WASTEWATER USING A SENSITIVE ELECTRODE (DIE POTENTIOMETRISCHE TITRATION VON SULFID IN ABWASSER MIT HILFE EINER SENSITIVEN ELEKTRODE),
VEB Wasserversorgung und Abwasserbehandlung, Dresden (German D.R.).
G. Sbieschni.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 101-105, 1980. 2 Fig, 8 Ref. (No English Summary).

Descriptors: *Sulfides, Wastewaters, *Potentiometers, *Pollutant identification, *Electrodes, Water analysis, Ions, Sensitive electrodes, *Titration, Water quality, Water pollution.

A method is described for the potentiometric precipitation titration of sulfide in wastewater using a sensitive electrode. The electrode consists of a sensor membrane screwed, glued, or pressed into an electrode shaft. The membrane is made of material that is conductive at room temperature, that has low solubility, and that is highly chemically and mechanically stable. The potential difference on the electrode surface arises from a grid defect mechanism: because the empty spots on the grid can only be occupied by ions of a similar size, the reaction is very specific. The measured electromotive force is dependent upon the activity of the test ion on the basis of Nernst's equation. For every power of ten change in activity, the potential of a univalent ion at a constant temperature changes by 0.058 volts. For wastewaters of varying composition, measurement of a uniform starting potential cannot be assumed. The multiplicity of interference moments means that Nernst's equation is only applicable without reservation when pure sulfide solutions are used. As a titrant, 0.01 N or 0.1 N AgN03 is used. The measuring equipment consists of a sensitive Ag/S electrode, a calomel electrode, an agitator, and a beaker as titration vessel. When the method was used for numerous wastewater samples from dye factories, overloaded treatment plants, and meat- and milk-processing concerns, it proved to be reliable and fast. The standard deviation (SD) for 0.55 mg sulfide was 0.06 mg (10%) and the confidence level (CL) was 0.04 mg (7%); 5.5 mg sulfide the SD was 0.31 mg (6%) and the CL 0.22 mg (4%). Iodometric sulfide determination for approximately the same concentrations had an SD of about 18% and a CL of about 12%. The method is not recommended for sulfide quantities < 0.2 mg. (Gish-FRC)
W83-02639

PRECONCENTRATION METHODS FOR THE ANALYSIS OF WATER BY X-RAY SPECTROMETRIC TECHNIQUES,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
R. Van Grieken.
Analytica Chimica Acta, Vol 143, p 3-34, 1982. 2 Fig, 2 Tab, 178 Ref.

Descriptors: *Literature reviews, *X-ray spectroscopy, *Separation techniques, *Water analysis, *Ion exchange, Reviews, *Spectroscopy, *Pollutant identification, Evaporation, Chemical precipitation, Chelation.

All the published procedures for multi-element preconcentration of trace elements prior to X-ray fluorescence analysis of water are reviewed and critically evaluated. Most of the preconcentration methods used in the determination of single elements in water are also listed. The 120 multi-element methods are categorized as evaporation techniques, ion exchangers, ion-collecting filters, precipitation and coprecipitation procedures, liquid-liquid extraction techniques, chelation and subsequent sorption immobilization methods, and electrodeposition procedures. Of the 43 single-element preconcentration procedures, 6 are concerned with the determination of uranium, 9 are for halide anions, 5 are for sulfur and sulfate anions, 3 are for chromium, and one method each is given for potassium, phosphorus, iron, nickel, arsenic, molybdenum, barium and mercury. Selection of a preconcentration procedure before X-ray fluorescence analysis depends on the type and variability of samples, the number and concentration of elements to be assayed, and the relative emphases placed on speed, quality and cost of the analysis. (Geiger-FRC)
W83-02654

A COMPARISON OF WATER SOLUBILITIES BY THE FLASK AND MICRO-COLUMN METHODS,
Keio Univ., Yokohama (Japan). Dept. of Applied Chemistry.
Y. Hashimoto, K. Tokura, K. Ozaki, and W. M. J. Strachan.
Chemosphere, Vol 11, No 10, p 991-1001, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Water analysis, *Solubility, Physical properties, Measuring instruments, Testing procedures, *Pollutant identification, *Organic compounds, Adsorption.

Ascertaining the water solubility of potential or known pollutants is an important factor in estimating their soil adsorption coefficients or bioconcentrations, and therefore in predicting their environmental fate and the likelihood of adverse effects in fish. The OECD 'Test Guideline: Water Solubility' recommends the microcolumn method for the solubility range of 10 mg/liter to 10 microg/liter. This method requires repeated concentration determinations to ensure that solution equilibrium has been achieved by passing water at a moderate rate through a small column packed with glass beads coated with the test compound, a tedious procedure. The flask method, commonly applied for more soluble compounds, was modified to cover compounds with solubilities of less than 10 mg/l using only two determinations, a preliminary and a final measurement. The solute to be tested was coated onto glass beads from an acetone solution; the mixture was agitated for 24 hr at 20C, equilibrated for an additional 48 hr at the same temperature, then filtered by suction and analyzed. Of the four filter types examined, the cellulose ester membrane filter adsorbed significant quantities of tested solutes, while the 0.3-0.7 micron glass fiber filters performed satisfactorily. (Baker-FRC)
W83-02670

DETERMINATION OF EDTA IN WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Institute for Land and Water Management Research, Wageningen (Netherlands).
J. Harmsen, and A. Van Den Toorn.
Journal of Chromatography, Vol 249, No 2, p 379-384, 1982. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Pollutant identification, *High performance liquid chromatography, *Gas chromatography, *Iron, *Metal complexes, *EDTA, Separation techniques, Water analysis, Industrial wastewater, Domestic wastes, Farm wastes, Heavy metals, Membrane filters, Chelating agents.

A high performance liquid chromatography (HPLC) method was developed for the determination of ethylenediaminetetraacetic acid (EDTA) in water. A solution of sodium chloride and glacial acetic acid served as eluant, and the samples were passed over a 0.45 micron membrane filter to prevent clogging of the chromatographic system. Prepared samples were kept in the dark until injection to prevent photochemical degradation of the EDTA. Iron (III) reagent in glacial acetic acid was also added to the sample to allow an adsorption maximum at a higher wavelength due to the iron(III)-EDTA complex. The method was linear in the range of 0-50 milligrams/liter in which EDTA may occur in polluted water samples. The addition of other heavy metals except for Co did not interfere with results. The detection limit was about 0.2 milligrams/liter. Comparisons of the HPLC method and a gas chromatographic (GLC) method for the determination of EDTA in groundwater samples showed that the HPLC method systematically gave results 13% higher than the GLC method due to the high iron content of the samples. In such cases, the HPLC method would be more realible than the GLC technique. It was also noted that sodium nitrate could be substitued for sodium chloride as eluant in the HPLC procedure. (Gieger-FRC)
W83-02676

MEASURING CHLORINE DIOXIDE WITH A ROTATING VOLTAMMETRIC MEMBRANE ELECTRODE.
West Virginia Univ., Morgantown. Dept. of Chemistry.
R. B. Smart, and J. W. Freese.
Journal of the American Water Works Association, Vol 74, No 10, p 530-531, October, 1982. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Chlorine dioxide, *Wastewater analysis, *Water analysis, Electrodes, Voltammetry, Monitoring, Automation, *Pollutant identification.

Chlorine dioxide in water and wastewater was detected at low concentrtions (less than 1 mg per liter) with a new rotating voltammetric membrane electrode. This detector is suitable for continuous automated monitoring. There are no interferences from hypochlorite, chlorite, chlorate, chromate, permanganate, ferric ion, or turbidity. At a chlorine dioxide concentration of 0.30 mg per liter the relative standard deviation was 6.4%. Results using the voltammetric membrane electrode compared well with the chlorophenol red method. The iodometric method gave higher results. (Cassar-FRC)
W83-02682

AQUEOUS ODOR AND TASTE THRESHOLD VALUES OF INDUSTRIAL CHEMICALS,
Dow Chemical Co., Midland, MI.
H. C. Alexander, W. M. McCarty, E. A. Bartlett, and A. N. Syverud.
Journal of the American Water Works Association, Vol 74, No 11, p 959-599, November, 1982. 4 Tab, 14 Ref.

Descriptors: Data collections, *Organoleptic properties, *Industrial chemicals, *Taste, *Odor, Industrial wastes, Spills, Water pollution effects, Water pollution sources, *Pollutant identification.

A study was conducted to generate odor and taste data for use in responding to emergencies in which a chemical has been spilled into public waters during its transport or storage. Data have been generated on odor thresholds for 63 industrial chemicals. Forty-six of these have also been evaluated for taste threshold. A triangle evalution procedure was used for the evaluation. A standard odor calibrating substance, 1-butanol, was used to compare these values with those reported in the literature. The sensitivity of the panel members to the standard was greater than that reported in the literature. Although threshold values were determined with water at 60 degrees C, these values should be applicable at ambient temperatures. The temperature effect appeared to be small. The lowest odor threshold value noted was 0.0008 mg/liter for number 2 fuel oil. Naphtha had the lowest taste threshold value, 0.02 mg/liter. (Baker-FRC)
W83-02684

DETERMINATION OF RADIUM-228 IN FOODS AND WATER,
Food and Drug Administration, Winchester, MA. Winchester Engineering and Analytical Center.
E. J. Baratta, and E. M. Lumsden.
Journal of the Association of Official Analytical Chemists, Vol 65, No 6, p 1424-1428, 1982. 2 Tab, 13 Ref.

Descriptors: *Pollutant identification, *Radium radioisotopes, *Water analysis, *Separation techniques, *Ion exchange, *Actinium, Radioisotoes, Radioactivity, Anion exchange, Cation exchange, Foods.

A method was developed for the rapid determination of radium (Ra 228) in foods and water by measuring its decay product actinium (Ac 228), which reaches a known secular equilibrium stage with a 6.1 hr half-life. Food samples can be prepared by wet- or dry-ashing techniques. The Ac 228 is precipitated from samples by a lanthanum carrier, dissolved, purified by solvent extraction, and decontaminated on anion and cation exchange resins. Radioactivity is measured in a thin-window, low level gas flow beta counter. Sample radioactivity may have to be counted several times to follow the half-life time of Ac 228 and ensure its purity. The method is sensitive to 1 pCi/sample of food ash and to 1 pCi/liter of wqter. To compensate for a counting error of 0.3 pCi/sample, the sample size for water may have to be increased to 4 liters. The decontamination factors are high for interfering radionuclides; the analysis does not require specialized equipment and may be performed fairly rapidly. (Geiger-FRC)
W83-02686

SIMPLE PAPER CHROMATOGRAPHIC METHOD FOR RAPID DETECTION OF CHROMATE (VI) IN FRESH WATER,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
S. Rajendrababu, and N. V. N. Kumar.
Journal of the Association of Official Analytical Chemists, Vol 65, No 6, p 1375-1378, 1982. 2 Tab, 11 Ref.

Descriptors: *Pollutant identification, *Separation techniques, *Water analysis, *Paper chromatography, *Metals, Metal complexes, Chromatography, Potassium compounds, Industrial wastes, *Chromium, Dehydrogenase, *Potassium dichromate.

A simple method was devised for the concentration and detection of potassium dichromate directly in fresh water. Freshwater samples spiked with potassium dichromate were concentrated by evaporation in a petri dish. After addition of buffer, the concentrates were applied by microcapillary to Whatman No. 3 filter strips for paper chromatographic separation using different acetone:EDTA:water solvent systems. After air drying, the strips were sprayed with pig liver acetone powder enzyme suspension or freshly prepard sheep liver homogenate. The strips were then oven dried and sprayed with sodium succinate-INT-PMS-buffer mixture before redrying. Potassium dichromate chromatographically separated with acetone:water:EDTA (75:20:5) gave a compact chromatogram visualized as a white inhibition area of succinate dehydrogenase at Rf 0.75. The method can also be used for the detection of potassium dichromate in 0.01 N acidic or alkaline water which is typical of industrial effluents. Acidity exceeding 0.01 N is likely to interfere with detection, but this problem may be overcome by sample dilution. In a spot test version of the method where potassium dichromate is applied on paper, as little as 2 micrograms can be detected without chromatographic separation. The method receives no interference from other common metal compounds and has a detection limit of 5 micrograms on the paper chromatography strip. (Geiger-FRC)
W83-02687

PERFORMANCE VARIABILITY, RANKING, AND SELECTION ANALYSIS OF MEMBRANE FILTERS FOR ENUMERATING COLIFORM BACTERIA IN RIVER WATER,
Columbus Dept. of Public Service, OH. Div. of Water.
R. C. Lorenz, J. C. Hsu, and O. H. Tuovinen.
Journal of the American Water Works Association, Vol 74, No 8, p 429-437, August, 1982. 4 Fig, 8 Tab, 42 Ref.

Descriptors: *Membranes, *Filtration, *Coliforms, Rivers, *Statistical methods, Bacteria, Membrane processes, Analysis of variance, Statistical analysis, Feces, Water pollution, *Pollutant identification, Ohio, Columbus.

Seven different kinds of membrane filters were evaluated for the enumeration of fecal coliforms in water samples from three rivers. Analysis ofvariance of filter performance indicated significant interaction between the filter and river water. The ranking and selection of filters was performed by using two different statistical procedures. A newly developed statistical method - MCB (Multiple Comparisons with the Best)- was introduced. None of the filters examined was found to be perfectly suitable for enumeration of fecal coliforms or total coliforms. Based on relative merits, two filters were outstanding: Millipore HC and Puropore filters. (Author's abstract)
W83-02690

ISOLATION OF NEW TYPES OF SULPHATE-REDUCING BACTERIA FROM ESTUARINE AND MARINE SEDIMENTS USING CHEMOSTAT ENRICHMENTS,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
S. M. Keith, R. A. Herbert, and C. G. Harfoot.
Journal of Applied Bacteriology, Vol 53, No 1, p 29-33, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Marine sediments, *Anaerobic bacteria, *Anaerobic conditions, *Culturing techniques, *Culture media, Estuaries, *Pollutant identification, Separation techniques, Agars, Growth media, Tay River estuary, *United Kingdom.

Anaerobic chemostat enrichments were developed which were successfully used for the isolation of acetate-utilizing, sulfate-reducing bacteria from sediments in the Tay estuary. Enrichments were performed in a single stage, 1-1 chemostat under carbon limitation at a dilution rate of 0.035 hr. The chemostat and medium reservoir were flushed with 10 milliliters of oxygen-free nitrogen/min. A continuous culture medium developed by Postgate (1966) was used with sodium lactate as carbon source. After the sediments were introduced, samples were aseptically removed at 2-day intervals and were transferred to agar shake dilution tubes. Pure cultures were obtained by repeated passages through agar shakes. Substrate utilization tests were performed to confirm the presence of acetate-utilizing, sulfate-reducing bacteria and the absence of contaminants. Using this procedure, several different morphological types of sulfate-reducing bacteria could be isolated from Tay estuary sediments in a controlled and reproducible system at low growth rates. (Geiger-FRC)
W83-02700

THE ISOLATION OF BACTERIOPHAGES FROM THE ENVIRONMENT,
Searle and Co. Ltd., High Wycombe (England). Searle Research and Development.
N. D. Seeley, and S. B. Primrose.
Journal of Applied Bacteriology, Vol 53, No 1, p 1-17, 1982. 3 Fig, 1 Tab, 102 Ref.

Descriptors: *Adsorption, *Viruses, *Ultrafiltration, *Separation techniques, *Bacteriophage, *Literature review, *Pollutant identification, Filtration, Dehydration, Enteroviruses, Adsorbents, Reviews, Microbiological studies, Indicators, Wastewater, Coliphages.

A review is presented of the different methods available for concentrating bacteriophages from the environment. Some modifications that may be made to the methods and some of the applications of the methods are also discussed. Enrichment techniques through selective culture media continue to provide a useful biological means for phage isolation. Ultracentrifugation and sample dehydration are physical methods of concentrating phage from large volumes of water. Some physicochemical methods of concentrating phage include phage adsorption and microporous filtration by electronegative or membrane filters. For concentrating human viruses, dehydration, filtration and freeze concentration have been successfully employed. Protamine sulfate has been used as an adsorbent of viruses from sewage and treated sewage effluents. Vegetable extracts, glass powder, and talc and Celite mixtures can all adsorb enteroviruses from water. Various eluants for isolated viruses and reconcentrating materials are discussed. Ultrafiltration is used routinely for reconcentrating eluants. Chaotropic agents which destroy hydrophobic bonding between filters and viruses will become important as aids to virus concentration. Some theories on virus adsorption mechanisms are presented. Selection of a concentration technique will depend on what type of viruses need to be isolated, the medium they are to be isolated from, and its volume. Phages may be used as specific cell surface probes, in selecting cell surface mutants, as indicators of water quality and as tracers of water movement. (Geiger-FRC)
W83-02708

VOLATILE ORGANIC COMPOUNDS IN WATER AT THIRTY CANADIAN POTABLE WATER TREATMENT FACILITIES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. Otson, D. T. Williams, and P. D. Bothwell.
Journal of the Association of Official Analytical Chemists, Vol 65, No 6, p 1370-1374, 1982. 3 Tab, 17 Ref.

Descriptors: *Organic compounds, *Pollutant identification, *Separation techniques, *Water analysis, Raw water, *Potable water, Gas chromatography, Organic solvents, Seasonal variation, Organic wastes, Treated water, Chloroform, *Canada.

A survey was made of a broad spectrum of volatile organic compounds in raw and treated water at 30 Canadian potable water treatment facilities using a static headspace technique and a dynamic headspace and liquid-liquid extraction procedure. The static headspace technique involved the use of a Tenax gas chromatographic column and a gas-tight syringe and was used for the determination of some very volatile alkyl halides which could not be easily detected by the other extraction methods. Of the 43 compounds studied, 27 were present in water samples. Chloroform and bromodichloromethane were detected most frequently in treated water, while trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, dichloromethane, benzene, toluene, ethylbenzene, and the xylenes occurred in both treated and raw water samples. Of the 43 compounds studied, 27 were present in water samples. Only chloroform occurred frequently at levels above 10 micrograms/liter in treated water. Concentrations of organic compounds were generally higher during August and September than they were in November and December. (Geiger-FRC)
W83-02715

TOXIC SUBSTANCES MONITORING PROGRAM - 1981,
California State Water Resources Control Board, Sacramento.
F. LaCaro, S. P. Hayes, D. Watkins, and C. Reiner.
Water Quality Monitoring Report No 82-3TS, December 1982. 54 p, 22 Fig, 11 Tab, 54 Ref, 5 Append.

Descriptors: *Toxicity, *Water quality data, *Water sampling, Pollutants, *Trace metals, Fish toxins, Organic compounds, *Pollutant identification, Aquatic animals, Aquatic plants, Fish populations, Mercury, DDT, Copper, *California, *Monitoring, Data collections.

Since 1977, this program has provided information annually on the statewide occurrence of toxic pollutants in aquatic biota, as well as an evaluation of trends or changes in pollutant levels to identify areas where action should be taken to reduce or eliminate pollution levels. In 1981, 22 species of predator and forage fish from 44 stations were analyzed for 10 trace metals and 66 synthetic organic substances. National Academy of Science (NAS) guidelines for maximum residues of toxicants in fish were equaled or exceeded 14 times while Food and Drug Administration (FDA) levels for toxic substances in fish for human consumption were exceeded only once. Per the NAS guidelines, mercury, toxaphene and total DDT concentrations approached or exceeded allowable levels at 5, 5, and 3 sites, respectively, while FDA limits for mercury were approached or exceeded at 2 sites. Copper concentrations were very high at 2 locales. Twenty-two synthetic organic compounds were detected at the parts per trillion level. Recommendations for future action include: analyzing individual organisms as well as different species in known problem areas; sampling identified problem areas less often so that efforts could center on other water quality problem areas; seeking the active participation of the Regional Boards and other agencies; developing a strong data base from which toxicant levels can be classified and later evaluated relative to their severity; continue developing sample consistency relative to species collection; studying toxicant concentrations in fish of different size, weight, age and species; and possibly using plant materials as water quality indicator organisms for selected toxicants. (Atkins-Omniplan)
W83-02719

AQUATIC HABITAT PROGRAM PLAN FOR ASSESSING THE EFFECTS OF POLLUTANTS IN THE SAN FRANCISCO BAY-DELTA ESTUARY,
California State Water Resources Control Board, Sacramento.

For primary bibliographic entry see Field 5C.
W83-02721

ASSESSMENT OF SURFACE WATER QUALITY AT SLECTED NORTHWESTERN WISCONSIN SITES BY COMBINED BIOLOGICAL AND CHEMICAL TECHNIQUES,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
T. P. Markee, D. A. Bahnick, D. J. Call, and L. T. Brooke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191890, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Publication No WIS WRC 83-04, Univ. of Wisconsin, Madison, 1982. 20 p, 6 Tab, 12 Ref. OWRT A-086-WIS(1), 14-34-0001-0153.

Descriptors: *Chemical analysis, Surface water, *Water quality, Algae, *Bioassay, Metals, Nutrients, Sampling, *Seasonal variation, *Wisconsin, *Algal assay, Water analysis, *Pollutant identification, Algal growth, Organic toxins, Phosphorus, Nitrogen, Inland lakes, Amnicon Lake.

Algal assays were utilized in this project for several types of studies: (1) determination of the water quality of several waterbodies in northern Wisconsin, (2) an attempt to develop an assay to indicate the presence or organic toxins, (3) seasonal variation in the ability of an inland lake to support algal growth, and (4) the comparison of a 48 hr bioassay technique with the standard 14 day test. The results of the water quality studies indicated that phosphorus was the limiting nutrient in waters from the three sample sites, and that nitrogen became limiting when phosphorus was added. Addition of the metal complexing agent--EDTA--caused changes in biomass production in two of the three sites. The attempt at developing a test for organic toxins was not successful because the extraction procedure seemed to remove nutrients or micronutrients resulting in decreased algal growth. Seasonal analysis of test samples resulted in only minor fluctuations in production from one month to another. The limited results of the 48 hr fluorescence test indicated comparable findings with that of the 14 day test.
W83-02736

ESTIMATION OF THE SEWAGE LOADING OF THE MEDITERRANEAN AT THE BEACHES OF VALENCIA, SPAIN (ESTIMACION DE LA CARGA CONTAMINANTE VERTIDA AL MAR MEDITERRANEO EN EL LITORAL PROXIMO A LA CIUDAD DE VALENCIA (ESPANA)),
Sociedad d'Aguas Potables Mejoras de Valencia (Spain).
For primary bibliographic entry see Field 5B.
W83-02796

5B. Sources Of Pollution

ACCLIMATION TO AND BIODEGRADATION OF NITRILOTRIACETATE (NTA) AT TRACE CONCENTRATIONS IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
R. J. Larson, and D. H. Davidson.
Water Research, Vol 16, No 12, p 1597-1604, December, 1982. 4 Fig, 4 Tab, 42 Ref.

Descriptors: *Nitrilotriacetic acid. *Degradation, *Detergents, Fate of pollutants, Acclimatization, *Biodegradation, *Microbial degradation, Kinetics.

Microbial acclimation to and degradation of nitrilotriacetic acid (NTA) was studied at concentrations up to 1000 micrograms per liter in river waters with varying histories of NTA exposure via detergents. In rivers previously unexposed to NTA, acclimation and degradation occurred at the lowest initial concentration, 1 microgram per liter. Degradation after acclimation followed apparent first-order kinetics. Half lives for NTA removal in the unexposed waters were 7 hours (at 50 micrograms per liter NTA) to 138 hours (5 micrograms per liter). No acclimation was observed before degradation in water samples previously exposed to NTA. In these waters first order rate constants varied only slightly over a 1000-fold initial concentration of 1-1000 micrograms per liter; half lives were 7-17 hours. The NTA levels found in the environment do not represent threshold concentrations for microbial action but rather steady state levels. (Cassar-FRC)
W83-02461

BEHAVIOR OF URANIUM IN TWO ESTUARIES OF THE SOUTHEASTERN UNITED STATES,
Tokyo Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 2L.
W83-02465

SEASONAL VARIABILITY OF BIOLOGICAL ARSENIC METHYLATION IN THE ESTUARY OF THE RIVER BEAULIEU,
Southampton Univ. (England). Dept. of Chemistry.
A. G. Howard, M. H. Arbab-Zavar, and S. Apte.
Marine Chemistry, Vol 11, No 5, p 493-498, 1982. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Seasonal variation, *Arsenic, *Methylation, Methyl arsenic, Rivers, Estuaries, Fate of pollutants, *Beaulieu River, Test River, Itchen River, *United Kingdom, Phytoplankton, Algae, Marine algae, Water temperature, *Path of pollutants.

Soluble arsenic species in surface water of the Rivers Beaulieu, Test, and Itchen near the Isle of Wight, England, showed strong seasonal variation. Inorganic arsenic (5+) concentrations ranged from 0.13 to 1.02 micrograms per liter throughout the year. Inorganic As(3+) and mono- and dimethylated As were absent during the winter months. The temperature range 9-12C was a transition region in which very small amounts of methylated As were formed. Above that range methylated As was detected in 80-100% of samples in concentrations of 0.06-0.38 micrograms per liter (monomethyl) and 0.16-0.42 micrograms per liter (dimethyl). Inorganic arsenic was detected in water of 3-6C and 12-18C but not at intermediate or higher temperatures. It was not possible to determine the specific organisms which participate in As methylation. Arsenite levels were higher in near bottom samples than in corresponding surface water samples, but no similar trend was seen in methylated As levels. This may reflect salinity stratification and remobilization of As from bottom sediments. (Cassar-FRC)
W83-02471

TRANSPORT OF ION-EXCHANGING SOLUTES DURING GROUNDWATER RECHARGE,
Stanford Univ., CA. Dept. of Civil Engineering.
A. J. Valocchi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190439, Price codes: A12 in paper copy, A01 in microfiche. Ph.D. Thesis, December 1980. 247 p, 89 Fig, 8 Tab, 94 Ref, 2 Append. OWRT C-80264-R(No 8824)(2), 14-34-0001-8824.

Descriptors: *Groundwater recharge, Model studies, *Ion exchange, Data collections, *Porous media, Water quality, *Solute transport, *Dispersion, *Chromatography, Soil columns, Path of pollutants, *Finite element analysis.

A mathematical model of the transport of ion-exchanging species governed by local chemical equilibrium was developed, based upon steady flow in a two-dimensional areal, confined, leaky aquifer system. The model equations were solved by use of the Galerkin-Finite Element Method. To study the effect of chemical parameter variations upon transport model behavior, a detailed chromatographic analysis of ion exchange in a non-dimensional soil column was also performed for both homovalent and heterovalent exchange in binary and ternary systems. The chromatigraphic analysis was extended to the case of ideal radial flow from a single injection well and was also used to investigate the effects of solution phase activity corrections and equilibrium model formulation upon the behavior of the transport model. The transport model was applied to a local field project involving direct injection of advanced-treated municipal effluents. Hydrogeologic parameters were determined by inspection of well logs and core samples. Tracer breakthrough data were used to determine an approximate velocity field and dispersivity values. Chemical parameters were measured using standard batch laboratory experiments on aquifer core material. The simulation model was then run to predict the breakthrough of sodium, potassium, magnesium, and calcium at various observation wells. The predicted results agreed very closely with the field data, showing that laboratory-determined chemical parameter values can be successfully used in field scale transport simulations, if the hydrogeologic and hydrodynamic parameters are selected to simulate reliably the movement of a conservative tracer.
W83-02478

THE MICROBIAL DYNAMICS OF AN EPILITHIC ALGAL-BACTERIAL MAT COMMUNITY IN AN OLIGOTROPHIC, HIGH ALPINE STREAM,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, and T. K. Haack.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186148, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 122, Bozeman, April 1982. 31 p, 6 Fig, 2 Tab, 27 Ref. OWRT A-131-MONT(1), 14-34-0001-1128.

Descriptors: *Microbiological studies, *Algal growth, *Heterotrophic bacteria, *Phototropism, Metabolites, *Montana, Algalmats, Sessile bacteria, Mountain streams.

Previous studies of an epilithic algal-bacterial community in a pristine mountain stream suggested that heterotrophic bacteria were responding to the metabolic activities of the phototrophic population. Subsequent studies were performed to follow the flow of labeled carbon, from its initial inorganic form, through the trophic levels of the mat community. A majority of primary production metabolites were excreted by the algal population during active growth; this shifted to an incorporation into cellular material as phototrophic activity declined. Results suggest that there was a direct flux of soluble algal products to the bacterial population, with little heterotrophic utilization of dissolved organics from the overlying stream water. Both phototrophic productivity and bacterial utilization of algal products peaked at approximately the same time of year. Activity of the diatom-dominated algal population declined as silica concentrations in the stream water dropped, leading to a situation in which the sessile bacteria were substrate limited. These events resulted in an almost complete disappearance of the community of the community in early September.
W83-02490

PARAMETERS OF DETERIORATING MICROBIOLOGICAL QUALITY OF SELECTED SURFACE WATERS IN RESIDENTIAL MISSOULA, MONTANA,
Montana Univ., Missoula. Dept. of Microbiology.
J. J. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186452, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Center Report No 121, Montana State Univ., Bozeman, October 1981. 59 p, 6 Fig, 5 Tab, 69 Ref. OWRT A-123-MONT(1), 14-34-0001-0128.

Descriptors: Water quality, *Water pollution sources, *Enteric bacteria, *Pathogenic bacteria, Salmonella, Shigella, Irrigation canals, Public health, Membrane filter techniques, Giardia, Candida, Leptospira, *Montana, Missoula.

Recreational and irrigation waters become fecally contaminated as they flow through urban and sub-

urban Missoula. In warm weather, when the microbiological burden is generally greatest, children play in the contaminated waters risking ingestion of infectious microorganisms. This investigation was undertaken to determine the potential health hazard of the contaminated streams and ditches in residential areas by determining the extent of identifying the sources of and demonstrating the presence or absence of infectious fecal contamination in those waters. Qualitative and quantitative procedures for detection and enumeration of waterborne Shigella, Salmonella, Giardia, Candida, and Leptospira species were examined and evaluated. A new procedure for detecting, differentiating and enumerating Candida Albicans in water was developed using immunofluorescence techniques. Routine membrane filtration was done on data from sixteen stations and fecal bacterial indicator densities were determined. Optional procedures developed during the early investigations were applied to demonstrate and enumerate specified pathogens. At no time was it possible to detect Salmonella, Shigella or Giardia spp. in the collections; leptospires and Candida spp. were frequently detected from mid-July until September. Only the Candida species included known pathogens.
W83-02492

THE INFLUENCE OF KOKANEE SALMON AND MAN ON THE WATER QUALITY OF LOWER MCDONALD CREEK, GLACIER NATIONAL PARK, MONTANA,
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 5C.
W83-02494

PCBS IN LAKE GENEVA (LAKE LEMAN) FISH,
Ecole Nationale Veterinaire de Lyon (France). Lab. de Toxicologie.
For primary bibliographic entry see Field 5C.
W83-02513

THE OCCURRENCE OF PCH3-CONTAINING COMPOUNDS IN SURFACE WATERS,
Prins Maurits Lab. TNO, Rijswijk (Netherlands). Inst. voor Chemische en Technologische Research.
For primary bibliographic entry see Field 5A.
W83-02518

THE EPA-TEST -- A METHOD FOR THE DETERMINATION OF PHOTOCHEMICAL DEGRADATION OF ORGANIC COMPOUNDS IN AQUATIC SYSTEMS (DER EPA-TEST--EINE METHODE ZUR BESTIMMUNG DES PHOTOCHEMISCHEN ABBAUS VON ORGANISCHEN VERBINDUNGEN IN AQUATISCHEN SYTEMEN),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Freising-Weihenstephan (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W83-02519

EFFECT OF SOIL AND CONIFEROUS TREES ON SOME CHEMICAL CHARACTERISTICS OF THE WATER OF RESERVOIR LG2 (INFLUENCE DES SOLS ET ARBRES NOYES SUR QUELQUES CARACTERISTIQUES CHIMIQUES DE L'EAU DU RESERVOIR LG2),
Laval Univ., Quebec.
J. B. Serodes.
Canadian Water Resources Journal, Vol 7, No 1, p 355-374, 1982. 4 Fig, 4 Tab, 13 Ref. English summary.

Descriptors: *Soil types, *Reservoirs, *Flooding, Water quality, Vegetation, Peat bogs, Oxygen consumption, Anaerobic conditions, Aerobic conditions, Potassium, Calcium, Tannins, Color, Conductivity, *Quebec, La Grande 2 reservoir, Fate of pollutants.

In order to evaluate the modifications of some chemical properties of the water of La Grande 2 reservoir after flooding, experiments were performed on spruce and pine undergrowth soil, on peat bog and on spruce and pine trees. The influence of continuously aerated water was first tested. Then, after oxygen consumption, the same sample was used to evaluate the changes occurring under anoxic conditions. The findings indicate that at the beginning of flooding in oxygen saturated water or at the beginning of anaerobic conditions, a rapid increase in conductivity, color, tannins, potassium and calcium occurs. These variations diminish rapidly after a few days. Generally, the release of biogenic substances is higher during continuous aeration than in anaerobic conditions. The contribution of trees to these changes is much more important than that of their respective undergrowth soils. (Baker-FRC)
W83-02520

SLUDGE DISPOSAL IN SOUTHERN CALIFORNIA BASINS,
California Inst. of Tech., Pasadena. Environmental Quality Lab.
For primary bibliographic entry see Field 5E.
W83-02527

PERSISTENT ORGANIC CHEMICALS IN SEWAGE EFFLUENTS. 2. QUANTITATIVE DETERMINATIONS OF NONYLPHENOLS AND NONYLPHENOL ETHOXYLATES BY GLASS CAPILLARY GAS CHROMATOGRAPHY,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5A.
W83-02529

ENTRAPMENT OF ZINC AND OTHER TRACE ELEMENTS IN A RAPIDLY FLUSHED INDUSTRIALIZED HARBOR,
Maryland Univ., College Park. Dept. of Chemistry.
S. A. Sinex, and G. R. Helz.
Environmental Science and Technology, Vol 16, No 11, p 820-825, November, 1982. 5 Fig, 3 Tab, 21 Ref.

Descriptors: *Zinc, *Industrial wastes, *Harbors, *Fate of pollutants, *Trace metals, Metals, Baltimore Harbor, Sediments, Estuaries, Chesapeake Bay, Silt, Dredging, Cobalt, Chromium, Vanadium, Patapsco River, *Maryland.

Analysis of sediment cores from 13 sites in Baltimore Harbor showed that Al-containing fine-grained argillaceous sediments, accumulated in the upper reaches of the Harbor, effectively trapped trace metals such as Zn. This region is rapidly flushed (10% renewal each day) because of an unusual three-layer circulation system: inflow of low salinity surface water and high salinity bottom water and outflow of intermediate salinity water between the two layers. Sediments have also been disturbed for decades by shipping activities and dredging. As a result, sediment cores have erratic vertical profiles, with highly contaminated sediments sometimes underlying less contaminated material. Harbor sediments contain high levels of metals compared with Chesapeake Bay sediments. Al content increases from 6% at the mouth to 8% at the upper reaches. Silicon levels decrease toward the harbor, while Fe concentrations are fairly constant. Patterns of metals enrichment in sediments are somewhat erratic. However, V shows no enrichment, except in near shore samples; Cr shows increasing enrichment (2-7 fold) from mouth toward the upper reaches; Co shows decreasing enrichment (3-1 fold) from mouth toward upper reaches; and Zn is enriched throughout the harbor (3-7 fold). Estimates of total contaminated sediments in the subestuary were 91-140 million cu m or 34-99 times ten to the 12th power g; total Zn, 28-82 billion g; anthropogenic Zn, 21-62 billion g. Estimating the anthropogenic Zn discharged up to 1980 using population growth and other data gave a value of 42 billion g Zn. (Cassar-FRC)
W83-02545

UPTAKE, DEPURATION AND BIOTRANSFORMATION OF ANTHRACENE BY THE SCUD PONTOPOREIA HOYI,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. F. Landrum.
Chemosphere, Vol 11, No 10, p 1049-1057, 1982. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Organic compounds, *Biotransformation, *Bioaccumulation, Food chains, Water pollution effects, Pontoporeia hoyi, Uptake, *Anthracene, Industrial wastes, Benthic environment, Great Lakes, Lakes, Temperature effects, Fate of pollutants, *Lake Michigan, *Scud.

Uptake, depuration and biotransformation rates of 14C-anthracene were determined for Pontoporeia hoyi, the dominant benthic invertebrate for the Great Lakes at 4, 7, 10 and 15 degrees C. The uptake rate constants for anthracene increased from 136 per hr to 215 per hr over the temperature range studied and were seasonally dependent. The depuration rate constant at the apparent optimum temperature of 7 degrees C was 0.015/hr for anthracene. The biotransformation ability of P. hoyi is low, and degradation of anthracene was undetectable even after exposures of 48 hr. The bioconcentration factor can be predicted from the uptake and depuration kinetics to be about 16,800 at 4 degrees C. These experiments imply that P. hoyi may be very important in the food chain biomagnification of some toxic organics. (Baker-FRC)
W83-02549

MERCURY CONCENTRATION IN LIVER AND MUSCLE OF COD (GADUS MORHUA) AS AN EVIDENCE OF MIGRATION BETWEEN WATERS WITH DIFFERENT LEVELS OF MERCURY,
Havforskingsinstutt, Bergen (Norway).
K. Julshamn, O. Ringdal, and O. R. Braekkan.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 5, p 544-549, November, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Fish, *Mercury, *Tissue analysis, *Accumulation, *Bioindicators, *Fjords, Cod, Bioaccumulation, Indicators, Contamination, Livers, Muscle, *Norway.

Cod (Gadus morhua) caught in Masfjord north of Bergen in May 1980 were studied for inorganic mercury and methylmercury uptake and depuration in laboratory feeding experiments. Cod caught in 1978 and 1979 in the Frierfjord at the south coast of Norway were analyzed for levels of mercury in liver and dorsal muscle by a cold vapor technique. Results showed that mercury was accumulated most rapidly in the livers of fish fed inorganic mercury during the first 8 days. For 2 weeks into the depuration period mercury continued to accumulate in the liver, but it declined steadily in both liver and muscle during the final 2 weeks. Fish fed methyl mercury showed a much higher uptake, but a different distribution pattern between the two organs. Levels in the liver leveled off after 8 days, while dorsal muscle continued to accumulate mercury for the whole 32-day feeding period. In the depletion period, the liver showed a decrease which mas most pronounced during the first week and continued until the last week of the experiment. These findings suggest that an internal redistribution of methyl-mercury takes place and that muscle tissue has a higher storage capacity than liver. These data also indicate that a muscle-liver ratio for mercury above 1 should show equilibrium with the environment. A plot of the muscle-liver ratios for cod caught in the Frierfjod area showed that less than half of the samples had a ratio exceeding 1, suggesting that cod from this environment may migrate between waters with different degrees of mercury contamination. Therefore, cod would not be a good indicator organism for mercury pollution in this area, nor could suitable relationships be drawn beteen fish age and levels of mercury accumulation in tissues. (Geiger-FRC)
W83-02553

RESTORATION OF THE CENTRAL LAKES: BALDEGGERSEE, HALLWILERSEE, AND SEMPACHERSEE. GENERAL OVERVIEW

(DIE SANIERUNG DERMITTELLANDSEEN: BALDEGGERSEE, HALLWILERSEE UND SEMPACHERSEE. ALLGEMEINER UBERBLICK),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
For primary bibliographic entry see Field 5G.
W83-02558

TRANSPORT AND FATE OF HEAVY METALS IN ONONDAGA LAKE, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, J. V. DePinto, and E. S. Seger.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 5, p 554-561, November, 1982. 6 Fig, 3 Tab, 11 Ref.

Descriptors: *Nickel, *Chromium, *Zinc, *Lakes, *Fate of pollutants, Mathematical models, *Heavy metals, Lake sediments, Sedimentation, Model studies, Simulation analysis, Mathematical studies, Epilimnion, Hypolimnion, *New York, Onondaga Lake, *Path of pollutants.

A simple, nonsteady state, deterministic model for prediction of the behavior of zinc (Zn), nickel (Ni) and chromium (Cr) in Onondaga Lake, New York was developed in three stages. In the first stage, important physical transport charateristics of the lake were described mathematically to include morphometric properties, point and non-point inputs, advective and dispersive fluxes, and outputs. Second, the transport model was calibrated for the period of study by a time-dependent mass balance on chloride ion. The calibrated tranport model then formed the basis for prediction of in-lake concentrations of the heavy metals. The calibrated model revealed that flow at the lake outlets may be unidirectional in either direction, or may be bidirectional. During bidirectional flow, water leaves Onondaga Lake from the hypolimnion of the north basin while water from the Seneca River enters the north basin epilimnion. The Nine Mile Creek tributary enters the hypolimnion of the north basin while about 10% of the flow from this creek reaches the outlet in the north basin without mixing. Horizontally, the lake is well-mixed, and the effect of thermocline migration on vertical dispersion was not important to in-lake transport. The model was recalibrated by adjusting for sedimentation coefficients and used to predict Zn, Ni and Cr loading in the lake. Comparisons with measured concentrations showed that the model accurately predicted the magnitude of heavy metal concentrations and general trend toward increasing or decreasing concentrations during the simulation period. Model estimates showed that 38% of the external Zn load and 36% of each of the Ni and Cr loads were lost to the sediments during the four month study period. (Geiger-FRC)
W83-02562

MUTAGENICITY OF SRC-II COAL LIQUEFACTION WASTEWATER TREATMENT RESIDUES,
Pittsburgh Univ., PA. Graduate School of Public Health.
For primary bibliographic entry see Field 5D.
W83-02564

INITIAL SEDIMENTATION OF WASTE PARTICULATES DISCHARGED FROM OCEAN OUTFALLS,
R. C. Y. Koh.
Environmental Science and Technology, Vol 16, No 11, p 757-763, November, 1982. 10 Fig, 8 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Sedimentation, Ocean bottom, Outfalls, Particulate matter, Organic matter, Santa Monica Basin, San Pedro Basin, *California, Settling velocity, Model studies, Fate of pollutants.

A model was developed to evaluate the physical pattern formed by discharge of sewage sludge particles into deep ocean basins from a 400 m deep outfall in the Santa Monica-San Pedro Basin off the California coast. Three types of information were needed: fall velocities of particles, ocean currents and density stratification at the site, and flow rate and other characteristics of the discharges. The fall velocities and currents were unavailable. Therefore, orders of magnitude for these data were used in the model. Model results showed that fall velocity is very variable and is influenced significantly by flocculation. Upon discharge the sludge would rise about 50 m above the bottom and then migrate toward the bottom by falling and downward diffusion. Only a few percent of the particles would settle within a kilometer of the outfall. About half of the sludge would be distributed over 100 sq km in an elongated, oblong-shaped region. This is caused by ocean currents which are stronger in the direction of the bottom contour axes. (Cassar-FRC)
W83-02565

EVALUATION OF ORGANOCHLORINE CONTENTS IN THE SAINT LAWRENCE RIVER, ESTUARY AND GULF, CANADA (EVALUATION DES TENEURS EN COMPOSES ORGANOCHLORES DANS LE FLEUVE, L'ESTUAIRE ET LE GOLFE SAINT-LAURENT, CANADA),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Environmental Pollution, Series B, Vol 3, No 4, p 239-270, 1982. 3 Fig, 12 Tab, 46 Ref.

Descriptors: *Reviews, *Water pollution, *Chemical analysis, Water analysis, Rivers, Lakes, Gulfs, *St. Lawrence River, Great Lakes Basin, *Canada, United States, River sediments, Sedimentation, *Organochlorines, Pesticides, Industrial wastes, Agricultural wastes, Fate of pollutants, Pollutant identification.

This literature review is based on reports and studies of concentrations of organochlorine compounds in the St. Lawrence River, Estuary and Gulf. The St. Lawrence River drains the Great Lakes Basin of Canada and the United States, which contains waters contaminated by organochlorine pesticides and polychlorobiphenyls (PCBs). The region of Montreal, as well as Lake Saint-Louis and Lake Saint-Francois, is the most contaminated area studied thus far. The sediments of Lake Saint-Louis generally contain 150 micrograms PCB/kg, while the river sediments south of Montreal island contain 75-140 micrograms/kg. In addition to these highly contaminated areas with respect to PCBs, the entire river between Cornwall and Ile d'Orleans is contaminated by organochlorine compounds. Both PCB and organochlorine concentrations in sediments and fish were highest in Lake Sain-Francois and decline downstream. The estuary and gulf areas are less contaminated than is the river, with 20-50 micrograms of PCB/kilogram of sediment being found at Ile D'Orleans and very low concentrations of PCBs and organochlorine compounds in fish flesh. Concentration gradients of PCB and organochlorine compounds in the estuary and gulf areas were not able to be defined. Concentrations were uniform and much lower than those measured in the river. (Baker-FRC)
W83-02578

TRACE ELEMENTS IN TISSUES OF COMMERCIAL FISH FROM LAKE LADOGA,
Ministerstvo Zdravookhraneniya URSR, Kiev. Inst. Biologicheskoi Fiziki.
P. I. Drovot.
Hydrobiological Journal, Vol 17, No 6, p 59-62, 1981. 2 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Fish, *Lakes, Water pollution effects, Iron, Manganese, *Trace elements, Metals, Cobalt, Copper, Lead, Zinc, Strontium, Nickel, Vanadium, Titanium, Zirconium, Lanthanum, *USSR, Lake Ladoga.

The results of a determination of 13 chemical elements in the tissues of eight species of edible fish from Lake Ladoga, caught in the summer of 1976 are presented. The highest concentrations of trace elements were found in the muscle and bony tissue of the roach, whitefish and ripus and the lowest concentrations in these tissues of the pike-perch and smelt. Lake Ladoga and its tributaries are inhabited by 58 varieties of fish. The variability in the concentrations of trace elements in the tissues of the different species of fish investigated depended on the habitat, physiological characteristics and mode of feeding. The content of trace elements in the tissues and organs of the fish increased in the following order: muscles, internal organs, skin, gills, skeleton and scales. Iron, manganese, zinc and strontium dominate among the elements studied. (Baker-FRC)
W83-02598

90SR AND 137CS IN BOTTOM SEDIMENTS OF A FRESHWATER LAKE,
Akademiya Nauk SSSR, Sverdlovsk. Inst. of Plant and Animal Ecology.
M. Ya. Chebotina, and V. F. Bochenin.
Hydrobiological Journal, Vol 17, No 6, p 77-80, 1981. 1 Tab, 14 Ref.

Descriptors: *Bottom sediments, *Lakes, *Trace elements, *Strontium, *Cesium, Natural waters, Sand, Peat, Lime, Sapropel, Sedimentation, Lake sediments, Fate of pollutants, Radionuclides.

Accumulation of Sr-90 and Cs-137 by four types of bottom sediments of a freshwater lake (sandy, peaty, lime and sapropel) was studied under natural conditions. It was noted that Sr-90 content in the sediments varied from 30 to 2300 pCi/kg (on a dry weight basis), and accumulation coefficients from 75 to 600. Sr-90 was absorbed mostly by peaty bottom sediment, and to the least extent by the sandy one. Cs-137 content in the bottom sediment was within the limits of 1700 to 3000 pCi/kg, and accumulation coefficients were 2000 to 4200. The highest degree of Cs-137 accumulation was registered for sapropel, which was due to its smaller particle size. (Baker-FRC)
W83-02599

LONG-TERM FATE OF ORGANOCHLORINE XENOBIOTICS IN AQUATIC ECOSYSTEMS. DISTRIBUTION, RESIDUAL BEHAVIOR, AND METABOLISM OF HEXACHLOROBENZENE, PENTACHLORONITROBENZENE, AND 4-CHLOROANILINE IN SMALL EXPERIMENTAL PONDS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
W. Schauerte, J. P. Lay, W. Klein, and F. Korte.
Ecotoxicology and Environmental Safety, Vol 6, No 6, p 560-569, 1982. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Chlorinated compounds, *Pesticide residues, *Aquatic life, Ponds, Organic compounds, Fate of pollutants, Hexachlorobenzene, Pentachloronitrobenzene, *Chloroaniline, Aromatic compounds, Sediments, Adsorption, Degradation, Aquatic plants, Fish, Invertebrates.

The fate of pesticides in pond water, sediments, and aquatic life was followed for up to 166 weeks after application over a 4-6 week period. Initial concentrations of hexachlorobenzene (HCB), pentachloronitrobenzene (PCNB), and 4-chloroaniline (CA) were 50 micrograms per liter. In the water phase half lives of HCB and PCNB after the last application were 1.3 and 1.8 days, respectively. CA was more persistent, with a first phase half life of 3 days and a second phase half life of 11 days. Rates of disappearances were partially correlated with physicochemical properties such as volatility and vapor pressure. Concentrations of all compounds were high in the biota in the first year but declined rapidly and remained very low thereafter. Sediment concentrations reached a peak early in the first year; those of HCB and PCNB declined sharply and remained low and those of CA declined gradually. After 3 years, residues of 0.1 mg per kg pesticide were detected in some fauna (backswimmers and libellula larvae) and in the 0-20 cm sediment layer. Three years after application the sediments still contained 7% of applied HCB and 6% of applied PCNB. No residues were found in the second crop of aquatic vegetation. No HCB conversion products were found. PCNB was quantitatively converted to pentachloroaniline and pentachlorothioanisole by 30 weeks after application. A brown film of CA degradation products was

seen on the surface of the water after 1 day. (Cassar-FRC)
W83-02608

DISTRIBUTION OF ACTINOMYCETES IN NATURAL WATERS (A SURVEY),
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova.
Hydrobiological Journal, Vol 17, No 6, p 24-31, 1981. 70 Ref.

Descriptors: Natural water, *Actinomycetes, *Bacteria, Water quality, Bottom sediments, Sediments, Water pollution sources, Reviews, Seasonal variations, Temperature effects, Algal growth, Algae, *Literature reviews.

A review of the literature is presented on distribution of actinomycetes in soils, bottom sediments, different water bodies and water courses. The effect of actinomycetes as antagonists and producers of biologically active metabolites on water quality is affected by seasonal dynamics, qualitative composition and physiological activity. The data indicate that the number of actinomycetes in bottom sediments is quite comparable to that in the soil, but that in water the numbers of these bacteria are tens of thousands of times smaller than in bottom sediments. Nevertheless, actinomycetes can develop in water, participating in the conversion of many substances within such waters. The relatively high rate of occurrence of actinomycetes in the water of estuarine regions of rivers, in inlets and shallows, as well as their response to man-made pollutants suggest that actinomycetes can act as indicators of such pollutants in water. Actinomycetes also serve as indicators in the trophic cycle and are involved in the conversion of various substances, promoting contamination and self-purification of waters. Questions of ecology of aquatic actinomycetes, the definition of their abundance, qualitative composition, role in the nutrition of aquatic animals, and their physiological and biochemical activity are areas indicated for further study. (Baker-FRC)
W83-02624

INVESTIGATIONS ON SEASONAL VARIATIONS OF SAPROBITY IN FLOWING WATER (UNTERSUCHUNGEN UBER JAHRESZEITLICHE VERANDERUNGEN DER SAPROBITAT IN EINEM FLIESSGEWASSER),
Wasserwirtschaftsdirektion Saale-Werra, Erfurt (German D.R.).
H. Ziemann, and W. Tumpling.
Acta Hydrochimica et Hydrobiologica, Vol 9, No 2, p 131-146, 1981. 3 Tab, 9 Fig, 17 Ref. (No English Summary).

Descriptors: *Saprophytic bacteria, *Seasonal variation, Running waters, *Water temperature, *Pollution load, Water pollution, Water quality, *German Democratic Republic, Rivers, Unstrut river, Organic loading, Chemical oxygen demand, Heterotrophic bacteria, Light intensity, Oxygen balance.

Saprobity (Pantle and Buck's saprobe index) and other water-quality factors (COD, oxygen, ammonium ions, temperature) were determined in the upper and middle reaches of the Unstrut river (German Democratic Republic) to investigate seasonal variation. Three sections of the river were distinguished: lightly polluted upper reaches, heavily polluted sections of the upper reaches, and moderately to heavily polluted (in fall, constantly heavily polluted) middle reaches. The middle reaches in spring and summer were autotrophic, and in fall and winter were heterotrophic, with a change in saprobity of one or two quality categories; this was effected by the heavy pollution in fall. Saprobity was correlated with COD-Mn ($r = =0.84$ at temperatures > 5 C, $+0.79 < 5$ C), oxygen saturation index ($r = -0.69$ both $>$ and $<$ 5 C), ammonium ions, and temperature itself except in the lightly polluted section ($r = -0.88$ and -0.81 for the heavily and periodically polluted sections, respectively; -0.21 for the lightly polluted section). In the upper reaches, organic pollution and oxygen concentration were most influential, while in the middle reaches, temperature and organic pollution were most important. The increase in saprobity noted in winter in heavily polluted running waters is not a natural phenomenon but is usually the consequence of the level of organic pollution in fall; after a critical threshold of pollution, autotrophic organisms cannot compete with heterotrophs, even after the pollution load is reduced. Only organic pollution was a determining factor for the stability of this ecosystem, while temperature and light served only to maintain stability after its level was established. (Gish-FRC).
W83-02640

DETERMINATION OF POLYNUCLEAR AROMATIC HYDROCARBONS IN THE NEW YORK BRIGHT AREA,
National Marine Fisheries Service, Gloucester, MA. Gloucester Lab.
A. W. Humason, and D. F. Gadbois.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 6, p 645-650, 1982. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Aromatic compounds, *Bights studies, *Marine animals, Water pollution sources, Oragnic wastes, Carcinogens, Fish, Mollusks, Crustaceans, *New York Bight, *Polynuclear aromatic hydrocarbons, New York.

Levels of 10 selected polynuclear aromatic hydrocarbons (PAH) were monitored in samples of winter flounder, window pane, red hake, rock crab, lobster, and sea scallops collected from the New York Bight and Long Island Sound regions. The specimens were frozen until analysis by high performance liquid chromatography. Results showed that of ten PAH compounds studied, the largest PAH concentrations found were for phenanthrene in the 50-200 parts per billion range (ppb). Concentrations for the other PAH compounds ranged from 0 to 50 ppb in most samples. Naphthalene, acenaphthalene, acenaphthene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene were detected the least frequently in the specimens studied. Low yields for benzo(a)pyrene were attributed to the rapid photodecompostion of this compound. Since sample size was so small and these data were intended to serve only as a baseline study, no geographic significance has been placed on these results. Followup studies will be needed to follow the extent of PAH pollution in the New York Bight area. (Geiger-FRC)
W83-02642

FATE OF ACETONE IN WATER,
Geological Survey, NSTL Station, MS.
R. E. Rathbun, D. W. Stephens, D. J. Shultz, and D. Y. Tai.
Chemosphere, Vol 11, No 11, p 1097-1114, 1982. 1 Fig, 4 Tab, 44 Ref.

Descriptors: *Acetone, *Volatility, *Degradation, Solvents, Organic compounds, *Fate of pollutants, Bacteria, *Biodegration, *Adsorption, Sediments, Streams, Rivers, Algae, Molds, *Photodegradation.

Volatilization and bacterial degradation were the dominant processes determining the fate of acetone in streams, according to results of laboratory studies, which also included the processes of adsorption by sediments, algae, and molds, and photodecomposition. Acetone volatilization coefficients, much smaller than oxygen absorption coefficients, were relatively independent of mixing conditions except in the low mixing range. The volatilization coefficients ranged from 0.625 per day for very low mixing conditions to 2.31 per day for very high mixing conditions. Bacteria preconditioned with a small concentration of acetone had a lag time before beginning of degradation of 1-3 hours, compared with nontreated bacteria with a lag time of 5-19 hours. Degradation rate coefficients were 0.79-7.9 per day for bacteria with no pretreatment and 0.43-3.4 per day with acclimated bacteria. It is expected that degradation rate coefficients in natural streams would be smaller than these values. Addition of a dye, Rhodamine-WT, to a water-acetone solution showed no significant photodecomposition of the acetone by the dye or of the dye by the acetone. Acetone did not significantly adsorb on sediments, algae, and molds. Initial acetone concentrations (mg per liter) in the experiments were: volatilization, 130; sediment adsorption, 38-925; bacterial degradation, 16-158; and algae and mold adsorption, 1.6-400. (Cassar-FRC)
W83-02645

POLLUTION OF DRINKING WATER WITH NITRATE,
Bremer Umweltinstitut fuer die Analyse und Bewertung von Schadstoffen (Germany, F.R.).
B. Gabel, R. Kozicki, U. Lahl, A. Podbielski, and B. Stachel.
Chemosphere, Vol 11, No 11, p 1147-1154, 1982. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Nitrates, *Manure, *Drinking water, Water pollution sources, Agriculture, Fertilizers, *Federal Republic of Germany, *Nonpoint pollution sources, Path of pollutants, Fate of pollutants.

High nitrate levels in drinking water in West Germany and intensive use of animal manures on agricultural land were highly correlated. Maps depict the areas of heavily cultivated land high nitrate levels in drinking water supplies, some over 250 mg per liter. The higher nitrate levels are found around Hamburg, Hanover, south of Bremen, west of Essen and Cologne, around Frankfurt, north of Stuttgart, northeast of Munich, in the Moselle Valley, and in several other regions. Only a few small areas of highly intensive cultivation were found without high nitrate concentrations in drinking water. (Cassar-FRC)
W83-02646

SIMULATION OF DECOMPOSITION OF PLANT MATERIAL AND FLOODED SOILS IN THE RESERVOIRS OF THE JAMES BAY REGION (SIMULATION DE LA DECOMPOSITION DE LA MATIERE VEGETABLE ET DES SOLS INONDES DANS LES RESERVOIRS DE LA REGION DE LA BAIE DE JAMES),
Sherbrooke Univ. (Quebec). Faculte des Sciences Appliquees.
N. Therien, G. Spiller, and B. Coupal.
Canadian Water Resources Journal, Vol 7, No 1, p 375-396, 1982. 10 Fig, 21 Ref.

Descriptors: *Model studies, *Water quality, *Reservoirs, Floods, Soil types, Vegetation, Hydraulics, James Bay, Fluid mechanics, *Decomposition, Water pollution sources, Desaulniers reservoir, Computer models, *Canada.

The effects of flooding of vegetation and soils on the water quality of the Desaulniers reservoir were considered. The reservoir is a small experimental reservoir located near the LG-2 reservoir. A computer model of the decomposition of flooded vegetation and soils was constructed. Inputs to the model consist of daily water temperature values, hydraulic convective mass flows entering the volume under study, and the initial state of the reservoir at the time of flooding. The type of soil and the distribution of vegetation species with their respective organic content are also initial inputs to the model. The model has been verified using experimental results available from flooded vegetation decomposition and soil leaching experiments. The model was run for two years after flooding. Model predictions are compared with available data for the Desaulniers reservoir and the influence of the hydraulic regime on the results are discussed. Management techniques include cutting or burning the vegetation before flooding. (Baker-FRC)
W83-02669

THE POPULATIONS, CHARACTERIZATION AND ACTIVITY OF SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
University Coll., Galway (Ireland). Dept. of Microbioloby.
D. Nuttall.
Journal of Applied Bacteriology, Vol 53, No 1, p 49-59, 1982. 5 Fig, 2 Tab, 42 Ref.

Descriptors: *Heterotrophic bacteria, *Water pollution sources, *Fate of pollutants, *Aerobic bacteria, Rivers, *Population dynamics, Pollutant identification, Bacteria, Pseudomonas, Alcaligenes, Flavobacterium, Seasonal variations, Escherichia coli, Dee River *Wales.

A 29-month study of the variations in total and aerobic heterotrophic bacterial populations from three sites on the River Dee and an evaluation of intensity differences and seasonal trends in potential heterotrophic activity were conducted from October 1975 to February 1978. Aerobic heterotrophic bacteria populations increased from an average basal level of about 12,000 colony-forming units (cfu)/milliliter at the river source to 200,000 cfu/milliliter in the lowland reaches. The total bacterial cell count: viable count ratio decreased from 70 in the upper reaches to 10 in the lower parts of the river. No seasonal variations were observed in bacterial numbers. Bacterial isolates from both upper and lower reaches were dominated by the Pseudomonas-Agrobacterium-Alcaligenes group and the Flavobacterium-Ctyophaga-Flexibacter group. Results suggest that the latter group may belong to the autochthonous population. Seasonal variation in heterotrophic potential for acetate uptake occurred over a 30-fold range in the lower reaches of the river. Peaks in activity in the lowland site occurred during the summer months, while fluctuations in heterotrophic potential for the upland site were not seasonal, but instead were associated with fecal pollution from sewage treatment facilities. (Geiger-FRC)
W83-02707

LONG-TERM TRENDS IN NITRATE CONCENTRATION IN IOWA WATER SUPPLIES,
Iowa Univ., Iowa City. State Hygienic Lab.
D. B. McDonald, and R. C. Splinter.
Journal of the American Water Works Association, Vol 74, No 8, p 8,437-440, August, 1982. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Nitrate, *Fertilizers, *Anhydrous ammonia, *Groundwater pollution, *Rivers, Water pollution, Water pollution sources, Agricultural runoff, Agricultural chemicals, Agricultural watersheds, Water quality, Shallow wells, Deep Wells, *Iowa.

Increases in nitrate concentrations in surface waters and shallow wells were found in long-term water quality studies in Iowa. High nitrate (more than 45 mg/liter) values were common during periods of relatively low river flow in the fall and winter. Nitrate infiltration of shallow aquifers was also evident from shallow well samples. The increased levels of nitrate were not unexpected because of the steady increase in the use of anhydrous ammonia in Iowa. Groundwater from deeper wells had much lower nitrate levels than groundwater from shallow wells. Nitrate contamination has not yet reached the deeper aquifiers. The future of nitrate contamination has not yet reached the deeper aquifers. The future of nitrate contamination in the area depends upon the use of fertilizer and other farming practices. (Small-FRC)
W83-02711

FATE OF NITROGEN IN SHALLOW STREAMS: FOCUS ON NITRIFICATION,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
J. J. Warwick, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191783, Price codes: A10 in paper copy, A01 in microfiche. Completion Report, Institute for Research on Land and Water Resources, The Pennsylvania State Univ., University Park, March 1983. 203 p, 35 Fig, 37 Tab, 138 Ref, 4 Append. OWRT B-123-PA(1), 14-34-0001-1260.

Descriptors: *Nitrogen, *Nitrification, *Denitrification, *Dissolved oxygen, *Mathematical models, Aquatic plants, Self-purification, Natural streams, *Pennsylvania, Marsh Creek, Pine Creek watershed.

A one-dimensional, pseudo unsteady-state water quality model was constructed to simultaneously solve nitrogen and dissolved oxygen mass balance equations developed for a stream environment. The nitrogen mass balance equations incorporate the following transformation pathways: ammonification, nitrification, bacterial and aquatic plant nitrogen assimilation, ammonia exsolution, and denitrification. The ammonification, nitrification, and denitrification reaction rates were treated optionally using either zero- or first-order kinetics. Submodels were developed to: (1) describe bacterial nitrogen uptake in terms of carbonaceous and nitrogenous biochemical oxygen demand removal rates, (2) estimate aquatic plant nitrogen assimilation from the variation in net primary productivity rates, and (3) calculate ammonia-N exsolution rates as a function of stream temperature and pH. The dissolved oxygen mass balance equation includes: atmospheric reaeration, carbonaceous deoxygenation, nitrogenous deoxygenation (nitrification), photosynthetic oxygen production, aquatic plant respiration, and benthal oxygen demands. Three separate water quality surveys were conducted to establish a data base for model calibration and verification. A shallow, headwater stream, exhibiting strong diel variations in pollutant loading and subsequent water quality response, was selected for investigation. The relative importance of all nitrogen transformation pathways was evaluated. The validity of utilizing observed variation in various nitrogen species concentration to estimate in-stream nitrification rates was investigated. The strong diel variation in calculated in-stream nitrification rates was related to observed variations in both stream temperature and pH.
W83-02723

CADMIUM FATE IN BACTERIAL MICROCOSMS,
Liege Univ. (Belgium). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W83-02764

HALTING CREEK POLLUTION,
Rogue Valley Council of Governments, Central Point, OR.
E. Dittmer.
Public Works, Vol 113, No 12, p 39-40, December, 1982.

Descriptors: *Animal wastes, *Coliforms, *Parks, Recreation, Water pollution sources, Streams, Urban areas, Water treatment, Chlorination, Raccoons, Bacteria, *Oregon, Bear Creeks.

Even after elimination of a sanitary sewer leakage into a storm drain feeding into Bear Creek, Medford, Oregon, coliform counts remained in excess of federal standards and thus posed risks for contact activity. Fecal bacterial pollution in this small urban park creek was traced to a three-member raccoon family living in a catch basin. Since all efforts to trap or exclude the animals failed, it was decided to treat the creek water by suspending 1 pound of swimming pool water purification tablets in the flow from a manhole upstream of the park. These tablets are renewed weekly on Thursday or Friday. Treatment is discontinued in winter. This treatment also controls pollution from pets which defecate in the park. (Cassar-FRC)
W83-02768

CONTAMINATION OF THE MEDITERRANEAN COAST AND ITS CONTROL AS A PROBLEM OF LAND MANAGEMENT (LA CONTAMINACION LITORAL MEDITERRANEA Y SU CORRECCION COMO UN PROBLEMA DE LA ORDENACION TERRITORIAL),
Valencia Univ. (Spain).
J. J. Diez Gonzalez, and R. M. Paz Doel.
Progress in Water Technology, Vol 12, No 4, p 771-780, 1980. 9 Ref. English summary.

Descriptors: *Water pollution sources, *Coastal waters, *Coastal zone management, Seawater, Wastewater, Wastewater disposal, Water pollution control, Mediterranean Sea, Valencia, Spain.

The extent of water pollution in the coastal areas of the Mediterranean Sea and the effectiveness of simple dilution as treatment are discussed. Decreases in fish catches in the Valencia region indicate that the pollution in the Mediterranean has passed the level that the sea can naturally absorb. It is necessary to investigate pollutants and their concentrations in waste discharges and seawater so that a solution such as wastewater treatment or a disposal system can be found. A coastal zone management policy that includes all areas of the sea is necessary. (Small-FRC)
W83-02777

POLYCHLORINATED BIPHENYLS IN THE SEDIMENTS OF THE INNER OSLOFJORD,
Oslo Univ. (Norway). Inst. of Marine Biology.
M. I. Abdullah, and O. Ringstad.
Water, Air, and Soil Pollution, Vol 18, No 4, p 485-497, 1982. 4 Fig, 4 Tab, 33 Ref.

Descriptors: *Polychlorinated biphenyls, *Fjords, *Sediment cores, Fate of pollutants, DDT, Pesticides, Insecticides, Chlorinated hydrocarbons, Organic compounds, Aromatic compounds, Oslo, *Norway, Organic matter.

Polychlorinated biphenyls (PCB's) and DDT were determined in sediment cores taken from the Inner Oslofjord, Norway, in 1980. Considerable industrial and domestic wastes are regularly discharged into this water, which has limited circulation and exchange. PCB concentrations were highly variable, 10-702 ng per g. Patterns were observed in 2 locations. In Bunnefjord the maximum PCB concentration was at 5 cm depth. In Vestfjord PCB levels were highest on the surface and decreased with depth. Compounds were fractionated according to chlorine content. In Bunnefjord sediments the proportion of 5 and 6-Cl compounds was constant with depth. In Westfjord sediments the proportion of 5-Cl compounds increased and 6-Cl compounds decreased with depth. The fraction of 7 and 8-Cl compounds remained constant throughout the area. Total DDT (metabolites found in all cores but 1) in sediments ranged from none detected to 978 ng per g. PCB levels were relatively uniform, considering the presence of waste outfalls. This is apparently a result of PCB association with organic matter and aquatic life and subsequent redistribution and bioperturbation, as illustrated by the sediment profiles at Bunnefjord approximately reflect the history of use and discharge of PCB's in the region. (Cassar-FRC)
W83-02783

HEAVY METALS IN WASTEWATER--ORIGINS AND SIGNIFICANCE (SCHWERMETALLE IM ABWASSER--HERKUNFT UND BEDEUTUNG),
Bundesamt fuer Umweltschutz, Bern (Switzerland). Abt. Naturwissenschaften und Fischerei.
H-P. Fahrni, and P. Ammann.
Wasser, Energie, Luft, Vol 73, No 3, p 29-31, March, 1981. 3 Tab, 10 Ref. English Summary.

Descriptors: *Heavy metals, *Sludge, *Industrial wastewater, *Municipal wastewater, *Storm wastewater, Precipitation, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Zinc, Sludge disposal, Fertilizers, Incineration, Air pollution, Pollutant identification, *Switzerland.

In the course of wastewater treatment, 1.8 million tons of sludge with 90,000 tons of dry matter are produced annually in Switzerland. This sludge contains about 6% of the phosphorus used as fertilizer in the country, but it can be utilized only if it is relatively free of heavy metals. Guidelines for heavy-metal content in sludge were laid down in 1975: they were designed for long-term fertilization with 2.5 tons dry matter/hectare/yr. Obligatory inspection of sludge in wastewater treatment plants serving > 10,000 clients has occurred since 1977 and has shown high cadmium (Cd), zinc (Zn), copper (Cu), and nickel (Ni) levels. Results of analyses of drinking water, domestic and industrial wastewater, and stormwater at treatment facilities in the Morges region on Lake Geneva showed that heavy metal content in precipitation and runoff had previously been underestimated: Cu, Fe, Mn, Pb, and Zn contents in domestic wastewater, stormwater, and runoff were far higher than those

in industrial wastewater--only 5-15% originated from galvanizing or metal-work industries. Industrial wastewater contained 30-50% of the Hg, Ni, and Cr measured. Cd originated to some extent in industrial wastewater, and to some extent in runoff (due to refuse incineration and fossil fuels). Of the Zn measured, 65% was from corrosion from water pipes, while some was found in highway runoff. Cu originated from domestic wastewater (pipes) and, to a greater extent, from runoff. More than 80% of Pb was found in street and roof runoff and in stormwater, the primary cause being leaded gasoline. Other studies have shown that soil erosion by wind, industrial air pollution, and refuse and other incineration processes produce heavy metal concentrations in precipitation that are far greater than those found in a moderately polluted river; more must be done to combat this. (Gish-FRC)
W83-02787

ESTIMATION OF THE SEWAGE LOADING OF THE MEDITERRANEAN AT THE BEACHES OF VALENCIA, SPAIN (ESTIMACION DE LA CARGA CONTAMINANTE VERTIDA AL MAR MEDITERRANEO EN EL LITORAL PROXIMO A LA CIUDAD DE VALENCIA (ESPANA)),
Sociedad d'Aguas Potables Mejoras de Valencia (Spain).
P. Marti Gallego, and J. Garcia Gomez.
Progress in Water Technology, Vol 12, No 4, p 441-454, 1981. 3 Fig, 5 Tab, 9 Ref. English summary.

Descriptors: *Bacterial analysis, *Chemical analysis, *Coastal waters, *Water pollution sources, Seawater, Wastewater, Water analysis, Agricultural wastes, Industrial wastes, Municipal wastes, Mediterranean Sea, Valencia, *Spain.

Contamination of the Mediterranean Sea by wastewater discharged from the Valencia (Spain) area was investigated. The region has changed from a primarily agricultural area to an industrial and urban center. Agricultural, industrial, and municipal wastes are discharged via an ancient complex network of canals. Water samples were collected at the mouths of the main streams discharging into the sea along the coastal zone between Carrainet creek and the new Turia river bed. Chemical and bacterial analyses were performed. Seawater in the area was also analyzed for bacterial content to study the extent of contamination by fecal matter. The observed contamination level was extremely high (BOD 22,740 metric tons total for the 6 sites tested). Chlorination of wastewater is recommended to prevent infection, especially by Salmonella, but would be expensive due to the high chlorine demand of the wastewater. (Small-FRC)
W83-02796

5C. Effects Of Pollution

QUANTIFICATION OF MECHANISMS RESPONSIBLE FOR BLUEGREEN ALGAL DOMINANCE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2H.
W83-02482

THE MICROBIAL DYNAMICS OF AN EPILITHIC ALGAL-BACTERIAL MAT COMMUNITY IN AN OLIGOTROPHIC, HIGH ALPINE STREAM,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W83-02490

PARAMETERS OF DETERIORATING MICROBIOLOGICAL QUALITY OF SELECTED SURFACE WATERS IN RESIDENTIAL MISSOULA, MONTANA,
Montana Univ., Missoula. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W83-02492

THE INFLUENCE OF KOKANEE SALMON AND MAN ON THE WATER QUALITY OF LOWER MCDONALD CREEK, GLACIER NATIONAL PARK, MONTANA,
Montana Univ., Missoula. School of Forestry.
G. T. Foggin, and B. R. McClelland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186478, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Center Report No 127, Bozeman, January 1983. 68 p, 10 Fig, 7 Tab, 18 Ref. OWRT A-122-MONT(1), 14-34-0001-0128.

Descriptors: *Fish, *Salmon, *Water pollution sources, *Decomposing organic matter, Annual waste, Sewage effluents, Dead fish, Carcass decomposition, Sewage irrigation, Stream pollution, Groundwater pollution, *Montana, MacDonald Creek.

Kokanee salmon (Oncorhynchus nerka) spawn each fall in lower McDonald Creek near the western boundary of Glacier National Park, northwestern Montana. This study was designed to: 1) determine the impact of salmon decomposition upon selected hydrochemical patterns in McDonald Creek; and 2) evaluate the impacts of a sewage sprayfield treatment facility and horse pasture upon selected chemical and bacteriological patterns of the creek. Streamflow and water quality relationships above Lake McDonald differed considerably from those in the spawning reach of the creek below the lake. There were no detectable increases in major ion concentrations during the 1979-1980 sampling period attributable to salmon decomposition. Nitrate-nitrogen concentrations did not increase below the salmon spawning area; however, total phosphorus exhibited a threefold increase in concentration coincident with initial carcass decomposition in late October 1980. The phosphate concentration patterns confirm fish migration as a recycling mechanism for selected critical nutrients. There is evidence of distinctive groundwater inputs from the vicinity of the sewage sprayfield into lower McDonald Creek immediately above its confluence with the Middle Fork of the Flathead River. Fecal coliform concentrations were generally less than one colony per 100 mls, except for several occasions at the downstream sampling stations during the 1979 fall season.
W83-02494

PCBS IN LAKE GENEVA (LAKE LEMAN) FISH,
Ecole Nationale Veterinaire de Lyon (France). Lab. de Toxicologie.
G. Monod, and G. Keck.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 5, p 570-576, November, 1982. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Bioaccumulation, *Fish, *DDD, *DDE, *DDT, *Polychlorinated biphenyl, Toxicity, Biomagnification, Perch, Roach, Pesticides, Halogenated pecticides, Fish eggs, Water pollution effects, Lake Leman, France, Switzerland, Gas chromatography.

Four species of fish (chars, coregonines, roaches, and perch) from Lake Leman, an important fishing lake for France and Switzerland, were analyzed for levels of DDE, DDD, DDT and polychlorinated biphenyls (PCB) by gas chromatography. There was a good correlation between PCB levels in different organs and their lipid contents when the fish were of the same species, age, and sex. In general, older fish were more contaminated than younger fish, and males were more contaminated than females. In order to make interspecies comparisons of PCB levels, the growth time of each species must be taken into account along with diet. Results of interspecies comparisons of PCB levels reflected the effects of biomagnification. PCB levels increased in the order of roaches, perches, and chars, an order consistent with their different degrees of carnivorous diet. PCB levels were lowest in coregonines, which are strict planktivores. In the present study, char eggs contained PCB levels of 14 to 22 parts per million on a lipid basis, a level consistent with high egg mortality in results from studies on other fish species. These findings may help to explain the decrease in char populations from Lake Leman in recent years. (Geiger-FRC)
W83-02513

EFFECT OF SOIL AND CONIFEROUS TREES ON SOME CHEMICAL CHARACTERISTICS OF THE WATER OF RESERVOIR LG2 (INFLUENCE DES SOLS ET ARBRES NOYES SUR QUELQUES CARACTERISTIQUES CHIMIQUES DE L'EAU DU RESERVOIR LG2),
Laval Univ., Quebec.
For primary bibliographic entry see Field 5B.
W83-02520

COOLING SYSTEMS: CAN ENGINEERS SAVE THE FISH,
Burns and Roe, Inc., Oradell, NJ. Hydraulic Engineering Dept.
For primary bibliographic entry see Field 8I.
W83-02551

THE SEASONAL VARIATION OF ORGANIC CONSTITUENTS IN A EUTROPHIC LAKE, LAKE SUWA, JAPAN. PART 1, PARTICULATE ORGANIC MATTER,
Nagoya Univ. (Japan). Water Research Inst.
T. Hamma, and N. Handa.
Archiv fur Hydrobiologie, Vol 93, No 4, p 446-465, March, 1982. 8 Fig, 1 Tab, 42 Ref.

Descriptors: *Organic matter, *Particulate matter, *Seasonal variation, Lakes, Lake Suwa, *Japan, *Eutrophic lakes, Chlorophyll a, Nitrogen compounds, Organic carbon, Carbohydrates, Protein, Algae, Phytoplankton, Cyanophyta, Diatoms, Nutrients, Water pollution effects.

Organic constituents (chlorophyll a, particualte organic carbon and nitrogen, carbohydrates, and protein) varied seasonally in Lake Suwa, a very eutrophic lake in Japan. Particulate matter was collected monthly from April 1979 to July 1980 from 0.5, 3, and 5.5 m depths. The vertical distribution was insignificant except for the summerof 1979, when levels of most organic substances were much higher at the surface than at greater depths. Chlorophyll a concentrations in surface water showed peaks during blooms of blue-green algae in July-September 1979 (120 micrograms per liter) and diatoms in March-April 1980 (60 micrograms per liter). Concentrations of other organic substances changed seasonally in the same pattern as chlorophyll a: particulate organic carbon, 0.7-11 mg C per liter; particulate organic nitrogen, 0.12-2.2 mg per liter; particualte carbohydrate, 0.22-3.5 mg per liter; and particulate protein (including amino acids and peptides), 0.70-2.7, 0.58-2.7, and 0.85-2.6 mg C per liter in water depths of 0.5, 3, and 5.5 m, respectively, with highest levels in summer and spring. Separation of the water-extractable organic substances from the particulate fraction collected in August-September revealed an accumulation of reserved polysaccharides composed largely of glucose units in the particulates. The ratio of particulates organic carbon to chlorophyll a in surface waters was 77, indicating that the diatoms and blue-green algae were actively growing cells. The ratio of particulate protein C to carbohydrate C tended to increase with an increase in concentration of total inorganic nitrogenous nutrients and decrease during algal blooms. (Cassar-FRC)
W83-02559

PESTICIDES IN GROUNDWATER: THE ALDICARB STORY IN SUFFOLK COUNTY, NY,
Suffolk County Dept. of Public Health, Hauppauge, NY.
For primary bibliographic entry see Field 5F.
W83-02560

VALUE OF INDIVIDUAL HOUSEHOLD WATER SUPPLIES IN THE MAINTENANCE PHASE OF A SCHISTOSOMIASIS CONTROL PROGRAMME IN SAINT LUCIA, AFTER CHEMOTHERAPY,
National Inst. for Medical Research, London (England). Div. of Parasitology.

For primary bibliographic entry see Field 5G.
W83-02561

EFFECTS OF NUTRIENT ENRICHMENT ON THE COLONIZATION AND DECOMPOSITON OF PLANT DETRITUS BY THE MICROBIOTA OF AN ARCTIC LAKE,
Cincinnati Univ., OH. Dept. of Biological Sciences.
T. W. Federle, V. L. McKinley, and J. R. Vestal.
Canadain Journal of Microbiology, Vol 28, No 11, p 1199-1205, 1982. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Oligotrophic lakes, *Litter, *Microbial degradation, *Detritus, *Adenosine triphosphate, Nutrients, Lakes, Rooted aquatic plants, Photosynthesis, Aquatic populations, Arctic zone, *Alaska, Toolik Lake.

The effects of nitrogen and phosphorus enrichments on the colonization and decomposition of sedge plant litter (Carex) by the microbiota of Toolik Lake, Alaska, were examined in laboratory microcosms. The addition of phosphorus caused a fourfold increase in the levels of ATP associated with the microbiota on fresh litter, while additions of nitrogen and phosphorus yielded only a twofold increase in the ATP associated with the microbiota of fresh or partially degraded litter compared with controls. The observed weight loss of fresh or partially degraded litter was not significantly affected by nitrogen or phosphorus enrichments alone or in combination. Additional phosphorus, when available, was immobilized by the litter microbiota. Further studies showed that the increase in ATP resulting from nutrient enrichment occurred only in daylight and not in the dark, suggesting nutrient stimulation of the photosynthetic component of the detrital community. (Geiger-FRC)
W83-02563

THE ECOLOGICAL CLASSIFICATION OF THE QUALITY OF SURFACE WATERS ON LAND, PRINCIPLES AND PRACTICAL EXPERIENCE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. N. Zhukinskiy, O. P. Oksiyuk, G. N. Oleynik, and S. I. Kosheleva.
Hydrobiological Journal, Vol 17, No 2, p 22-33, 1981. 3 Tab, 34 Ref.

Descriptors: *Classification, *Water quality, *Surface water, Ecology, Ions, Mineralization, Trophic level, Physical properties, Chemical properties, Bacteria, Phytolankton, Organic matter, Indicators, Nutrients, Water pollution effects.

An updated system for classification of surface water quality is presented. It incorporates physical and chemical indicators reflecting the composition and properties of the water in terms of abiotic and biotic indicators. The general classification uses two subclassifications: (1) extent of mineralization and ionic composition and (2) ecological and public health classification. The salinity indicator is divided into freshwater (alpha and beta hypohaline and alpha and beta oligohaline), brackish water (alpha and beta mesohaline and polyhaline), and salt water (euhaline and ultrahaline). Ionic composition classifies the waters into hydrocarbonate, sulfate, and chloride, each with Ca, Mg, and Na subgroups. The ecological and public health classification divides waters into five main classes: of utmost purity, pure, of adequate purity, polluted, and dirty. Each of these is described by indicators: (1) hydrochemical (suspended solids, transparency, and color), (2) trophic indicators (hydrophysical and hydrobiological), (3) bacteriological (bacterioplankton, heterotrophic bacteria, E. coli group), and (4) biological indicators (saprobity). Since water quality is a result of the complex interaction of natural conditions and man's activities, the contribution of each cannot be easily defined. This classification system reflects the background water quality without separating the two types of effects. It is not designed to replace existing State Standards, which establish threshold values for various indicators. Rather, the classification can indicate the suitability of various waters for specified uses, such as irrigation. (Cassar-FRC)
W83-02569

NICKEL TOXICITY TO FUNGI: INFLUENCE OF ENVIRONMENTAL FACTORS,
New York Univ., NY. Lab. of Microbial Ecology.
H. Babich, and G. Stotzky.
Ecotoxicology and Environmental Safety, Vol 6, No 6, p 577-589, 1982. 13 Fig, 29 Ref.

Descriptors: *Nickel, *Toxicity, *Fungi, Water pollution effects, Metals, Heavy metals, Hydrogen ion concentration, Humic acid. Chlorophyll, Water hardness, Growth rates, Inhibition, Microorganisms.

The effects of environmental factors on nickel toxicity to filamentous fungi were determined. Statistically significant growth reduction was observed at Ni concentrations of 5 ppm for Achyla sp.; 10 ppm for Saprolegnia sp. and Cunninghamella blakesleeana; and 10 ppm for Aspergillus clavatus and A. flavus. Total inhibition of growth occurred at 50 ppm Ni for A. flavus and 50-100 ppm for the other four fungi. Increasing pH from mildly acid to neutral or alkaline eliminated Ni toxicity at concentrations of 20 ppm Ni or less. Addition of Mg or Zn (but not K, Na, Ca, or ferric) ions reduced the toxicity of 10 ppm Ni to Achyla sp. A combination of Ni and Pb was strongly antagonistic toward fungal growth, but the interactions between Ni and Cd and between Ni and Hg were less well defined. Chlorophyll, at 1%, reduced Ni toxicity toward Saprolegnia and C. blakesleeana. Increasing the chlorophyll concentration from 0.2 to 1% progressively reduced Ni toxicity to A. clavatus. Addition of 1% hymic acid reduced Ni toxicity to Saprolegnia and C. blakesleeana, and increasing humic acid levels from 0.2 to 1% progressively reduced toxicity of Ni toward A. flavus. Inhibition of A. flavus was more pronounced at 23C at 33C. (Cassar-FRC)
W83-02582

LARGE-SCALE DEVELOPMENT OF CERATAULINA BERGONII PERAG IN THE NORTHWESTERN PART OF THE BLACK SEA,
D. A. Nesterova.
Hydrobiological Journal, Vol 17, No 6, p 19-23, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Seas, *Eutrophication, *Algal growth, Nutrients, Water quality, *Black Sea, Cerataulina bergonii, Temperature effects, Seasonal variation, Algae, *USSR.

Eutrophication of the northwestern Black Sea is the major reason for large-scale development of C. bergonii, which is most abundant near the Dniester estuary. Its vertical distribution exhibits a single peak in the hyponeuston layer. Cell size, and therefore biomass, are higher in the zone of vegetative growth, whose location is a function of the degree of eutrophication. The dimensions of the cells were determined on seven samples, selected on the basis of the spatial and vertical distribution of C. bergonii. The pelagic, neritic plankton C. bergonii is widely distributed in the Black Sea. In September of 1975 the numbers were nonuniformly distributed in the northwestern area of the Sea. When the temperature on the sea surface ranged from 18.4 to 21 degrees C and there was an abundance of nutrients, an explosive growth of C. bergonii occurred. The spatial and vertical distributions of C. bergonii in the Dniester-Danube interfluve were controlled by the nutrient-carrying river flows. It was concluded that eutrophication of the coastal zones of the northwestern Black Sea led to an increase in cell volume, which was reflected in the quantity of the biomass. Thus it becomes necessary to calculate separately the average weight of the cells of one species in the sea areas with high and low vegetation of these cells. (Baker-FRC)
W83-02602

HYDROBIOLOGICAL CONDITIONS IN THE KARAKUMY CANAL,
Akademiya Nauk Turkmenskoi SSR, Ashkhabad. Inst. Botaniki.
For primary bibliographic entry see Field 4A.
W83-02625

ECOLOGICAL FOUNDATIONS OF MEASURES TO PROTECT THE HYDROSPHERE AGAINST MAN-MADE POLLUTION,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 6G.
W83-02626

BIOMASS OF MARINE MACROFAUNA COMMUNITIES IN A DUMPING AREA OF SEWAGE SLUDGE NEAR THE ELBE ESTUARY (DIE BIOMASSE MARINER MAKROBENTHOS-GESELLSCHAFTEN IM BEMUNDUNG),
Zoologisches Inst. und Museum, Hamburg (Germany, F.R.).
U. Muhlenhardt-Siegel.
Helgolander Meeresuntersuchungen, Vol 34, No 4, p 427-437, 1981. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Sludge disposal, *Microenvironment, *Environmental effects, Land disposal, Mud, Biomass, Seasonal variation, Polychaetes, Crustaceans, Echinoderms, *Federal Republic of Germany, Elbe River estuary.

The macrofauna of a dumping area in the eastern part of the German Bight (North Sea) was investigated during July, August and November of 1978 at five stations situated on a transect including central and peripheral areas of the dumping region. Abundance and biomass (ash free dry weight) of the macrofauna and its variation from July to November were analyzed as well as biomass of different taxa. Molluscs dominated over polychaetes, crustaceans and echinoderms. A positive correlation appeared between mud content and biomass at the peripherally situated stations. In the central sewage sludge area, however, the biomass values were reduced. In late autumn the biomass decreased in the entire area due to the death of Diastylis rathkei, Abra alba and Pectinaria koreni. These species were replaced by the mollusc Nucula turgida and polychaete Nephtys hombergii. In autumn the biomass values also showed a distinct minimum at the central stations. (Baker-FRC)
W83-02627

INVESTIGATIONS ON SEASONAL VARIATIONS OF SAPROBITY IN FLOWING WATER (UNTERSUCHUNGEN UBER JAHRESZEITLICHE VERANDERUNGEN DER SAPROBITAT IN EINEM FLIESSGEWASSER),
Wasserwirtschaftsdirektion Saale-Werra, Erfurt (German D.R.).
For primary bibliographic entry see Field 5B.
W83-02640

SELENIUM ACCUMULATION AND CYTOTOXICITY IN TELEOSTS FOLLOWING CHRONIC ENVIRONMENTAL EXPOSURE,
Texas Univ. at Austin. Dept. of Pharmacology.
E. M. B. Sorensen, T. L. Bauer, J. S. Bell, and C. W. Harlan.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 6, p 688-696, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Selenium, *Sunfish, *Regression analysis, *Water pollution effects, Reservoirs, *Tissue analysis, Fish, Fish physiology, Fish toxins, Histology, Ecological effects, Industrial wastes, Lakes, Metabolism, Fate of pollutants.

Fish of the Centrarchidae family, green sunfish and redear sunfish, were collected from four sites of Martin Lake, a reservoir that was subject to selenium (Se) pollution from systems used to collect fly ash, scrubber ash and bottom ash. Cytologic examinations, hematocrit determinations and neutron activation analysis were performed on selected fish tissues. Linear regression of Se concentration in skeletal muscle on Se concentration in the hepatopancreas of redear sunfish from two sites in the reservoir showed that a highly significant correla-

tion exists between Se levels in these two tissues. All redear sunfish muscle samples from fish collected near a recognized Se discharge site were well above the 2 ppm level. Regardless of species, more Se was detected in sunfish from Martin Lake than in fish collected from reference lakes used in this study. Green sunfish appeared to be edematous from both condition factor data and organ data. Histological studies showed abnormalities of the exocrine pancreas, ovaries, mesonephros, gill lamellae and myocardium in Se exposed fish. Changes in the hepatopancreas, mesonephros and ovaries were similar for both redear and green sunfish, while reactions of the other affected tissues to Se exposure differed in these two species. (Geiger-FRC)
W83-02659

HEMOGLOBIN-GLUTATHIONE RELATIONSHIPS IN TROUT ERYTHROCYTES TREATED WITH MONOCHLORAMINE,
Seattle Metro Water Quality Lab., WA.
J. A. Buckley.
Bulletin of Environmental Contamination and Toxicology, Vol 29, No 6, p 637-644, 1982. 5 Fig, 18 Ref.

Descriptors: *Trout, *Disinfectants, *Hemoglobin, *Monochloramine, Fish, Fish physiology, Water pollution effects, Oxidation, Disinfection, Blood, Regression analysis.

The relationship between hemoglobin and reduced glutathione (GSH) in trout erythrocytes treated with monochloramine, a widely used drinking water and wastewater disinfectant, was examined in laboratory tests. In human erythrocytes in vitro, monochloramine has been shown to inhibit the hexose monophosphate shunt activity critical to maintaining glutathione in the reduced form. Preparations of trout erythrocytes exposed to monochloramine and control preparations were analyzed for recovery of hemoglobin and GSH after various incubation periods. Regression equations were used to calculate the percentage of GSH remaining after monochloramine treatment, along with the pecentage of sulfhemoglobin and methemoglobin formed. Results showed that the reaction of GSH was approximately equimolar with the initial concentration of monochloramine. The empirically derived equation for the oxidation of hemoglobin and depletion of GSH by monochloramine in rainbow trout erythrocytes provides a quantitative basis for examining the relationships between reactants and products during rapid oxidative changes. The production of sulfhemoglobin prior to complete methemoglobin formation may be due to incomplete oxidation, resulting in a mixture of tetramers at all stages of heme oxidation. (Geiger-FRC)
W83-02660

THE POPULATIONS, CHARACTERIZATION AND ACTIVITY OF SUSPENDED BACTERIA IN THE WELSH RIVER DEE,
University Coll., Galway (Ireland). Dept. of Microbioloby.
For primary bibliographic entry see Field 5B.
W83-02707

FEASIBILITY OF INACTIVATING PHOSPHORUS WITH ALUMINUM SALTS IN BALL POND, CT,
Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5G.
W83-02718

AQUATIC HABITAT PROGRAM PLAN FOR ASSESSING THE EFFECTS OF POLLUTANTS IN THE SAN FRANCISCO BAY-DELTA ESTUARY,
California State Water Resources Control Board, Sacramento.
G. E. Johns, and R. Bachman.
Publication No 82-7SP, October 1982. 49 p, 19 Fig, 14 Tab, 158 Ref, 6 Append.

Descriptors: *Monitoring, *Water quality standards, Water quality, Pollutants, *Effluents, Bays, Water pollution sources, Wastewater management, Cost-benefit analysis, Water pollution control, *Aquatic life, Hydrodynamics, Model studies, *California, San Francisco Bay-Delta estuary.

This Plan is the State Water Resources Control Board's attempt to make water quality monitoring of pollutants in this water body comprehensive, coordinated and cost-effective. Pollutants in the Bay affect indigenous organisms directly or combined with other pollutants, and flow patterns are complex; thus, the usual chemical analyses are inadequate. The Plan has two main concepts: using several types of biota to monitor pollutant effects, since normal appearances and physiological responses would show acceptable pollution levels; and developing a hydrodynamic model to predict movement of wastewater plumes. These concepts are considered in the Plan's six elements. The Regional Effects Element will monitor discharge effects which cannot be measured near release sites because the effects occur later and at a distance from the sites; long-term changes in the biota are assessed. The Local Effects Element will isolate specific sources of changes, and are short-term studies carried out near significant discharges. Effluent Assessment will identify specific constituents of effluents causing adverse affects to test organisms. The Hydrodynamic Element would be a vital link between basinwide regional effects and local pollution sources using existing data to create a composite model. The Coordination Element is needed to maximize the acquisition and desseminination of reliable water quality information in a cost-effective manner. The Research and Special Studies Element will provide flexibility in dealing with the unexpected, a way to understand the processes affecting the uptake of pollutants by plants and animals, and the mechanism regulating interaction between organisms and their environment. (Atkins-Omniplan)
W83-02721

THE SEPARATION OF THERMAL AND CHEMICAL EFFECTS IN EVALUATING GEOTHERMAL INFLUENCES ON AQUATIC BIOTA,
California Univ., Berkeley. Div. of Entomology and Parasitology.
V. H. Resh, G. A. Lamberti, E. P. McElravy, and J. R. Wood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191908, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, March 1983. 55 p, 8 Fig, 49 Ref. OWRT-A-084-CAL(1).

Descriptors: *Geothermal studies, *Geyers, *Thermal springs, Thermal stress, Thermal powerplants, Thermal pollution, Thermal water, Chemical composition, *Chemical degradation, Benthic fauna, Aquatic life, Macroinvertebrates, *California, Big Sulphur Creek, Geyers Creek.

In this study a field based, stream microcosm system to experimentally separate the effects of the thermal and chemical components of geothermal fluids on the benthic community was developed. Using this system the separate and combined influences of these components on the numerical abundance of bacteria, the standing crop and productivity of algae, and the density, standing stock, and community structure of macroinvertebrates were evaluated. This microcosm study was designed on the basis of the results from an instream study, which was a natural comparison of benthic communities in geothermaliy influenced and uninfluenced stream segments. Additionally, a new type of field experiment to determine the upper lethal temperature thresholds for three insect species found in a geothermally influenced stream was developed. This heat shock experiment simulated acute thermal effects on organisms that drift into the lethal temperature zones that seasonally occur in geothermal streams. It also mimicked the effects of heated effluents on aquatic organisms that are drawn into the cooling water intake of a power plant, or entrained in the discharge plume. Although the instream study demonstrated that a moderate addition of geothermal fluids into a non-geothermal stream could substantially alter the structure of the benthic community, the analysis did not establish the cause of the alteration. The stream microcosm study demonstrated that the thermal component of those geothermal fluids had greater influence than the chemical component in determining the structure of the benthic community. (Synder, California)
W83-02738

CADMIUM FATE IN BACTERIAL MICROCOSMS,
Liege Univ. (Belgium). Dept. of Botany.
J. Remacle, C. Houba, and J. Ninane.
Water, Air, and Soil Pollution, Vol 18, No 4, p 455-465, 1982. 8 Fig, 5 Tab, 19 Ref.

Descriptors: *Cadmium, *Bacteria, *Accumulation, *Fate of pollutants, Water pollution effects, Bioaccumulation, *Productivity.

Cultures of a river bacterial community were exposed ot 0.5 mg per liter Cd at 10 and 20C at high and low levels of bacterial productivity. At 20C the population rapidly reached productivity levels around the control value. At 10C productivity was reduced to about 50% of control values by Cd contamination. At 20C Cd accumulation by bacteria was controlled by bacterial productivity. At low productivities, for example 2.4 mg per liter per hour, Cd accumulation in bacteria was 1288 mg per kg (dry weight) bacteria. Only 20% of available Cd was attached to cells. However, at high productivities (301.4 mg per liter per hour) 341 mg Cd per kg bacteria accumulated and 86% of Cd was associated with cells. The calculated binding capacity was 1540 mg Cd per kg. About 90% of the accumulated Cd was located in the wall-membrane fraction of both Cd-resistant and Cd-sensitive cells. Cd concentrations in bacteria decreased more slowly than theoretical calculations indicated. It was assumed that the reason for this lag was release of Cd from the bacteria attached to the wall of the vessel and subsequent uptake by free bacteria. (Cassar-FRC)
W83-02764

THE EFFECTS OF LIMNOLOGICAL PROCESSES ON THE QUALITY OF IMPOUNDED WATERS (AUSWIKUNGEN LIMNOLOGISCHER VORGANGE AUF DIE BESCHAFFENHEIT VON STAUGEWASSERN),
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W83-02784

5D. Waste Treatment Processes

EFFLUENT LIMITATIONS BASED ON WATER QUALITY,
Delaware State Dept. of Natural Resources and Environmental Control, Dover. Water Resources Section.
For primary bibliographic entry see Field 5E.
W83-02466

THE EFFECT OF CHLORINE DIOXIDE SUBSTITUTION IN THE FIRST STAGE OF PULP BLEACHING ON BLEACH PLANT EFFLUENT BOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. W. Reeve.
Pulp and Paper Canada, Vol 82, No 10, p 78-80, October, 1981. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Chlorine dioxide, *Bleaching, *Kraft mills, *Pulp wastes, *Effluents, Chlorine, Industrial wastes, *Wastewater treatment, Chemical oxygen demand, Carbohydrates.

In the first stage of bleaching of softwood and hardwood kraft pulps using chlorine dioxide substitution for chlorine, most investigators have found a modest decrease in effluent biological oxygen demand (BOD). Voss et al. (1979) found an increase in bleach plant BOD on switching to chlorine dioxide due to an increase in the extraction

stage BOD, while the first stage BOD remained relatively constant. In contrast, other researchers have found more first stage material dissolved on use of chlorine dioxide with a higher molecular weight of the material dissolved, a factor which would mitigate against greater biodegradability particularly in the second stage. Extensive mill experience has shown that it is possible to achieve only 14 kilograms BOD/ton of pulp including the contributions from black liquor carried into the bleach plant and from all bleaching stages. Increased yield of bleached pulp with increased use of chlorine dioxide has been reported and is suggested to be due to decreased carbohydrate degradation by chlorine, leading to decreased dissolution of carbohydrates, particularly in the second stage. (Geiger-FRC)
W83-02469

MAXIMIZING AQUACULTURAL POTENTIAL IN MUNICIPAL WASTEWATER PONDS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 3C.
W83-02485

SIDESTREAM TREATMENT OF HIGH SILICA COOLING WATER AND REVERSE OSMOSIS DESALINATION IN GEOTHERMAL POWER GENERATION,
Permutit Co., Inc., Paramus, NJ.
For primary bibliographic entry see Field 3A.
W83-02486

OZONALYSIS FOR WATER REUSE APPLICATIONS,
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W83-02498

THE EXPANSION OF THE USTER WASTEWATER TREATMENT FACILITY--FOURTH TREATMENT STAGE--WASTEWATER FILTRATION FACILITY (DIE ERWEITERUNG DER KLARANLAGE USTER, 4. REINIGUNGSSTUFFE, ABWASSWERFILTRATIONSANLAGE).
Wasser, Energie, Luft, Vol 74, No 1/2, p 7-11, January/February 1982. 9 Fig. (No English Summary).

Descriptors: *Wastewater facilities, *Construction, *Flocculation, *Filtration, *Phosphorus removal, Eutrophic lakes, *Wastewater treatment, *Switzerland, Uster, Greifensee, Gravity filters, Municipal wastewater, Construction costs.

The addition of a wastewater filtration facility to the existing three stage plant (mechanical, biological, simultaneous phosphate precipitation) at Uster on the Greifensee in Switzerland is described. The construction of the facility was rendered necessary by the ever-increasing eutrophication of the lake. The existing facility removed 80-90% of phosphate from wastewater to a residual of approximately 1 mg total phosphorus/1, while it was projected that the filtration plant would reduce phosphorus a further 80%, to a residual of 0.2 mg/1. Flocculation-filtration was the method of choice. The filtration facility consisted essentially of a raw water pumping station with two worm-driven pumps and eight open gravity filters. The 2-m-thick filter material was composed of a lower layer of quartz sand and an upper, coarser layer with a smaller specific gravity. Peripheral elements of the plant included the chemical dosing station, the backwash aggregate and the switching and control stations. The addition of chemicals (iron sulfate and a flocculating agent) caused flocculation of dissolved phosphates, which could then be trapped in the filter. With the facility operating at full capacity, daily phosphate discharge into the Greifensee could be reduced from 9.8 tons/yr to 2.0 tons/yr. The choice of site and site-specific construction requirements are discussed. The cost of the facility was projected at 5.38 million Swiss francs in 1979. (Gish-FRC)
W83-02503

WASTEWATER SLUDGE DISINFECTION WITH GAMMA-RAYS: AN OVERVIEW (KLARSCHLAMMHYGIENISIERUNG MIT GAMMA-STRAHLEN: EIN UBERBLICK),
Sulzer Bros. Ltd., Winterthur (Switzerland).
H. Herrnhut.
Wasser, Energie, Luft, Vol 74, No 1/2, p 21, January/February, 1982. 1 Fig, 2 Ref. (No English Summary).

Descriptors: *Disinfection, *Sludge, *Gamma radiation, *Wastewater treatment, Pathogens, Enteric bacteria, *Federal Republic of Germany, Radiation, Agriculture, Fertilizers, Sludge thickening, Energy sources, Cobalt radioisotopes, Wastewater treatment facilities.

The Sulzer gamma-radiation facility for the disinfection of sludge to be used for agricultural purposes at Geiselbulach (Federal Republic of Germany) is described. The facility has operated since 1973 and treats anaerobically stabilized sludge. The sludge is loaded into an above-ground silo (5.6 cu m capacity), then lowered into the radiation shaft, where it is rotated by means of pumps and thereby passes in front of the radiation source several times. Studies have shown that a dose (i.e., energy absorbed in the material) of 3,000 Gray (or 300 kilorads = 3 kilojoules/kg) is sufficient to eliminate pathogens. The dose, together with the activity of the radioactive source, determine the irradiation time. Cobalt-60 radiation sources are housed in the double walls of a central pipe in the radiation shaft and are cooled constantly by water with a separate circulation. Radiation with 3,000 Gray results in an average reduction of total bacteria and of enterococci by 2 orders of magnitude and of enterobacteriaceae by 5 orders of magnitude. Fecal bacteria and salmonella concentrations do not increase during sludge thickening in dry beds, but are instead further reduced with long storage times. Settling and thickening properties improve after irradiation; in a few days, dry matter content increases from 4 to 8-10%. Irradiated sludge is highly effective when used as a fertilizer: in field studies, sludge fertilization resulted in an up to 20% higher corn yield than full mineral fertilization. A simple synergism can be achieved by a combination of radiation and oxygen treatment, thereby reducing radiation dose and costs. (Gish-FRC)
W83-02505

THICKENING AND BIOLOGICAL DISINFECTION OF WASTEWATER SLUDGE BY SUBMERSED ROTATION AERATION (EINDICKUNG UND BIOLOGISCHE ENTSEUCHUNG VON ABWASSERSCHLAMM DURCH SUBMERSE UMWALZBELUFTUNG),
Mangold A.G., Basel (Switzerland).
F. Popel, and S. Mangold.
Wasser, Energie, Luft, Vol 74, No 1/2, p 16-18, January/February, 1982. 2 Fig. (No English Summary).

Descriptors: *Biological wastewater treatment, *Sludge thickening, *Disinfection, *Aeration, Aerators, *Wastewater treatment, Energy, Heating, Pathogenic bacteria, Organic matter.

Sludge thickening by flotation and disinfection and disinfection by submersed rotation aeration present energy efficient and effective alternatives to conventional methods. Wastewater sludge can be thickened in a shorter time than by gravity thickening by the introduction of small air bubbles, which results in a solids-rich foam in which 6-10% of sludge solids content is floated out. This procedure is conducted in a flotation thickener with a pear-shaped floor plan in which flotation air is introduced by an underwater rotating aerator of a size such that 50-80 Watts of drive power is exercised on 1 cu m of usable tank content. The foam rises to the surface over a sloping skimmer weir, after which a skimmer facilitates the escape of air bubbles and pushes it into the disinfection tank. Thickened sludge with a high organic content can be disinfected by the addition of oxygen and simultaneous rotation of the entire tank contents by an underwater rotating aerator. This procedure causes exothermic biochemical reactions in the substrate that provide good conditions for eliminating all pathogenic organisms as well as the risk of reinfection. It also leads to autoheating of the sludge (to 40-50C when an average of 8.4 kilo-Watt hours is used to disinfect 1 cu m of sludge) and an increase in its pH (to 8-8.5 under the same conditions). This provides for subsequent digestion temperatures of 35-37C without the need for an outside energy source. This method allows the biological disinfection of sludge in 5-9 days. (Gish-FRC)
W83-02506

A PROCESS FOR THE BIOLOGICAL DISINFECTION OF SLUDGE (EIN VERFAHREN ZUR BIOLOGISCHEN HYGIENISIERUNG VON KLARSCHLAMM),
Cetec-Engineering A.G., Turgi (Switzerland).
R. Schweri.
Wasser, Energie, Luft, Vol 74, No 1/2, p 19-20, January/February, 1982. 4 Fig, 5 Ref. (No English Summary).

Descriptors: *Sludge digestion, *Wastewater treatment, *Disinfection, *Biological treatment, *Aerobic conditions, Anaerobic conditions, Anaerobic digestion, Pasteurization, Wastewater treatment facilities, Construction, Costs, Sludge disposal.

The Cetec biothermal process for the disinfection of sludge to be used for agriculture is described. The process is designed to eliminate some of the problems of conventional thermal pasteurization, in which almost all microorganisms are killed so that the sludge possesses no resistance against reinfection, in which crusts are easily formed on heat exchangers, and in which complicated controls (usually only possible in large facilities) are required to avoid wastage. The biothermal process accelerates a natural process and consists of aerobic-thermophilic disinfection followed by anaerobic digestion that can be conducted at high temperatures. The first, aerobic stage lasts 2.5-3.5 days, with at least 12 hours at a temperature of $>$ 50C. Heat is produced by aerobic microorganisms utilizing available heat and is intensified by the use of aerators. Oxygen utilization can be as much as 90%. The second stage is to be conducted at the highest possible temperature. The warm, pretreated sludge is not cooled before treatment. New digestion towers may be built as efficient process reactors. Smaller (and cheaper) digestion tanks can be used, as the digestion process is complete in only 10-12 days. A heating system is not required, and all gas produced in the digestion tower can be used for purposes other than heating the sludge. Experience with this process has been good so far, and the method can be used in both large and small wastewater treatment facilities. (Gish-FRC)
W83-02507

ELECTROFLOTATION PURIFIES CHEMICAL WASTEWATER (ELEKTROFLOTATION REINIGT CHEMIEABWASSER),
Wasser, Luft, und Betrieb, Vol 26, No 4, p 18, 1982. 2 Ref. (No English Summary).

Descriptors: *Chemical wastewater, *Flotation, *Flocculation, *Wastewater treatment facilities, *Secondary wastewater treatment, Sludge, Wastewater treatment, Sludge dewatering, Energy, Construction costs, *Federal Republic of Germany, *Electroflotation.

Electroflotation is used as the second stage in wastewater treatment facility at a petro-chemical plant in the Federal Republic of Germany. Electroflotation was chosen to supplement the original gravity wastewater treatment facility when it was realized that conventional settling would not be effective, because the pollutants to be removed were lighter than water. Conventionl flotation methods are energy-intensive and difficult to control, and the size of the air bubbles is unpredictable (often resulting in 'boiling' of polluted water and destruction of the flocs). Electroflotation avoids this, as gas bubbles are produced on the floor of the treatment basin in a consistently tiny size by electrolysis of water on electrodes. Water is pumped through a dosing channel with a specific throughput time; here flocculation by means of metal salts and pH conditioning occur. Optimal precipitation of metal hydroxides follows in a

slightly turbulent reaction tank by the addition of flocculating agents (polyelectrolytes). The treated and neutralized water is separated from the sludge by electroflotation. The sludge is periodically removed by pneumatic suction; the gas-containing floating sludge reaches a few centimeters above the water line and is thus partially dewatered. The advantages of this procedure include optimal pollutant removal, low chemical and energy requirements, short treatment time, compact construction, and flexible operation. The cost of the facility described was 1.5 million DM. The system was housed in a single building and was automatically monitored and shut down in the case of substandard treatment. (Gish-FRC)
W83-02508

WATER DISINFECTION WITH THE HYDROGEN PEROXIDE-ASCORBIC ACID-COPPER(II) SYSTEM,
Alexandria Univ. (Egypt). Dept. of Soil and Water Services.
N. J. Ragab-Depre.
Applied and Environmental Microbiology, Vol 44, No 3, p 555-560, September, 1982. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Disinfection, *Bacteria, Water treatment, *Hydrogen peroxide, *Ascorbic acid, *Copper, Streptococci, Clostridium perfringens, Yeasts, Molds, *Wastewater treatment.

The study of the bactericidal effects of a ternary disinfectant system is reported. The treatment of secondary effluents with hydrogen peroxide-ascorbic acid-copper(II) for 60 min resulted in about 99% reduction of the initial plate count. Hydrogen peroxide could be replaced by other peroxygen compounds; ascorbic acid could be replaced by other reducing compounds, of which sodium sulfite and ethanol were most effective. Copper, however, could not be replaced by other metals without loss of bactericidal efficiency of the ternary combination. Enterobacteriaceae, total and fecal coliforms, staphylococci, and micrococci were reduced by 99.0 to 99.9%. Group D streptococci and aerobic spores were reduced by 80 and 15%, respectively. Clostridium perfringens, yeasts and molds were not killed by the disinfectant combination. The effect of pH was minor in the range from 6 to 7.5. At a higher pH value the bactericidal effects tended to decrease. The hydrogen peroxide-ascorbic acid-copper combination made it possible to obtain 99% reductions in 30 min. Copper combined with an intermediate product of the ascorbic acid autoxidation is the toxic agent, and its penetration into the cell is promoted by hydrogen peroxide. (Baker-FRC)
W83-02511

INTERACTIONS BETWEEN AMINO-ACID-DEGRADING BACTERIA AND METHANOGENIC BACTERIA IN ANAEROBIC DIGESTION,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
M. Nagase, and T. Matsuo.
Biotechnology and Bioengineering, Vol 24, No 10, p 2227-2239, October, 1982. 8 Fig, 3 Tab, 12 Ref.

Descriptors: *Anaerobic digestion, *Bacteria, *Wastewater treatment, *Amino acids, Chemical reactions, Hydrogen ions, Degradation, Biodegradation, Organic compounds, Methanogenic bacteria.

The degradation of amino acids in anaerobic digestion was examined in terms of the interactions between amino-acid-degrading bacteria and methanogenic bacteria. Certain amino acids were degraded oxidatively by dehydrogenation, with methanogenic bacteria acting as hydrogen acceptors. The inhibition of methanogenesis by chloroform also inhibited the degradation of these amino acids and/or caused variations in the composition of volatile acids produced from them. The presence of glycine reduced the inhibitory effect of chloroform, probably because glycine acted as a hydrogen acceptor in place of methanogenic bacteria. This fact suggested that the coupled oxidation-reduction reactions between two amino acids - one acting as the hydrogen donor and the other acting as the hydrogen acceptor - may occur in the anaerobic digestion of proteins or amino-acid mixtures. The conversion of some proteins to volatile acids was not affected when methanogenesis was inhibited by chloroform. This suggested that the component amino acids of proteins may be degraded by the coupled oxidation/reduction reactions and that the degradation of proteins may not be dependent on the activity of methanogenic bacteria as hydrogen acceptors. (Baker-FRC)
W83-02515

ORGANIC CHEMICAL FIRE IN ILLINOIS: EMERGENCY RESPONSE AND CLEANUP,
Illinois State Environmental Protection Agency, Springfield.
For primary bibliographic entry see Field 5G.
W83-02516

ORGANIC CARBON REMOVAL BY ADVANCED WASTE WATER TREATMENT PROCESSES,
Washington Univ., Seattle. Dept. of Environmental Health.
F. B. DeWalle, W. G. Light, and E. S. K. Chian.
Environmental Science and Technology, Vol 16, No 11, p 741-746, November, 1982. 4 Fig, 3 Tab, 26 Ref.

Descriptors: *Reverse osmosis, *Organic carbon, *Oxidation, Wastewater treatment, *Advanced wastewater treatment, Tertiary wastewater treatment, Ozonation, Hydrogen peroxide, Ultraviolet radiation, Ion exchange, Ferrates, Persulfates, Perborates, Pemanganates.

Reverse osmosis at an 85% permeate recovery removed more organic carbon (> 90%) from advanced wastewater treatment effluents (with about 5 mg per liter total organic carbon) than other processes and combinations of processes tested. There was no difference in organic removal between reverse osmosis alone and reverse osmosis before or after activated carbon treatment. Polyamide hollow fiber membranes were more effective than cellulose acetate membranes. A 700-fold excess of ozone and ozone/ultraviolet treatment removed 65% and 77%, respectively, of the organic carbon. Organic removal with hydrogen peroxide was 94% at a 40,000 mg per liter dose and 0.3% at 40 mg per liter. Results using hydrogen peroxide/ultraviolet and hydrogen peroxide with 10 mg per liter Fe catalyst were no different than using hydrogen peroxide alone. Ultraviolet alone did not reduce organic carbon levels. Evaluation of other processes produced poor to moderate carbon removals. These were: ion exchange, ozone/activated carbon, hydrogen peroxide/ultraviolet plus activated carbon, ferrate, persulfate, perborate, and permanganate. (Cassar-FRC)
W83-02528

INDUSTRIAL EFFLUENT CONTROL EXPERIENCE,
Thames Water Authority (England). Northern Div.
P. Brindley, D. C. Carter, and M. J. Linsmith.
Effluent and Water Treatment Journal, Vol 22, No 8, p 303-307, 310, August, 1982. 2 Fig, 5 Tab, 2 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, Heavy metals, Sludge, Acidity, Oils, Dissloved solids.

Examples of industrial effluent control procedures are described as applied to industrial waste treatment, persistent organic chemicals and toxic metals. Due to the difficulty of removing diluted pollutants the methods employed relate to control at source, supported by monitoring and information storage to define the input-output equation for the particular substances. Thus effort is directed at preventing the effects of waste treatment from becoming irreversibly damaging to the environment. Particular information if given on a plant designed to deal with five main recognizable groups of waste: free non-volatile oils; emulsified oils; acidic waste with a pH value below 4.0 and possibly containing metallic contaminant in the form of soluble salts; miscellaneous wastes which have some solids in suspension and mild acidity; and sludges normally neutral, but containing more than 2% settleable solids. Treatment for each waste type is briefly discussed along with catchment quality control. Limits set on industrial effluents are cited. (Baker-FRC)
W83-02530

FIELD PERFORMANCE OF RBC'S.
Water Research Centre, Stevenage (England).
E. B. Pike, C. H. Carlton-Smith, R. H. Evans, and D. W. Harrington.
Effluent and Water Treatment Journal, Vol 22, No 9, p 342, 344-345, 347-354, September, 1982. 4 Fig, 7 Tab, 57 Ref.

Descriptors: *Wastewater treatment, *Rotating biological contactors, Oxidation, Biological films, Pollutants, Literature review, Industrial wastes.

The Water Research Centre's program of investigation of the performance of rotating biological contactors (RBC) was extended in 1975-78 to study factors affecting the performance of commercial units installed at sewage works and to study the variability in composition of sewage and of effluents. Specific factors adversely affecting performance at the village works were organic overloading and mixing of liquors between treatment units. Hydraulic overloading by infiltration had little effect at one site. The effect of organic loading rate was not clear, as it was confounded by differences in design. Sets of data for composition of sewage and effluents were distributed about log-normally, andfor sets of samples taken throughout treatment, the variance of BOD and suspended solids was related to the arithmetic mean by a power law. It is suggested that this relationship may be general and could be used to calculate percentile values for any given mean value of effluent quality. Performance and rates of treatment given by the 30-population-equivalent unit were greater on the average and sludge production was lower in the year when flow varied over a diurnal cycle than in the previous year of operation with steady flow at the same average rate, although the average strength of the settled sewage was greater in the second year. (Baker-FRC)
W83-02533

MUTAGENICITY OF SRC-II COAL LIQUEFACTION WASTEWATER TREATMENT RESIDUES,
Pittsburgh Univ., PA. Graduate School of Public Health.
G. Keleti, J. Bern, M. A. Shapiro, W. P. Gulledge, and G. T. Moore.
Environmental Science and Technology, Vol 16, No 11, p 826-830, November, 1982. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Mutagens, *Coal liquefaction, *Sludge, Fate of pollutants, Wastewater treatment, Sludge digestion, Carcinogens, Organic compounds, Polycyclic aromatic hydrocarbons, Aromatic compounds.

Sludge from an SRC-II coal liquefaction wastewater treatment plant and a solid waste (vacuum bottoms) exhibited some mutagenicity as determined by the Ames Salmonella/microsome test. Two sample sets of these substances were tested as a whole and as hexane, toluene, methylene chloride, and acetonitrile fractions. Vacuum bottoms in both sample sets had the highest mutagenic activity, 2875 and 11,095 revertants per mg. Mutagenic activities (in revertants per mg) of wastewater treatment sludges were: alum sludge, 7705; clarifier sludge, 4.050 and 0.932; and digester sludge, 0.530 and 1.273. Mutagenicity varied between the two sample sets and with type of sludge. This was evident in results from solvent fractionation. Clarifier sludge (fresh) and its four fractions were more mutagenic than digested sludge (aged). Digestion of the sludge greatly reduced mutagenic activity in the methylene chloride and acetonitrile fractions, slightly reduced activity in the hexane fraction, and did not reduce activity in the toluene fraction. The bulk of the polycyclic aromatic hydrocarbons are in the toluene and hexane fractions.

The polycyclic aromatic hydrocarbons present in the methylene chloride and acetonitrile fractions were apparently amenable to oxidative metabolism. (Cassar-FRC)
W83-02564

AEROBIC THERMOPHILIC DIGESTION OF SEWAGE SLUDGE,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
For primary bibliographic entry see Field 5E.
W83-02568

THE REMOVAL OF NITRILOTRIACETIC ACID AND ITS EFFECT ON METAL REMOVAL DURING BIOLOGICAL SEWAGE TREATMENT: PART I - ADSORPTION AND ACCLIMATISATION,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. C. Rossin, R. Perry, and J. N. Lester.
Environmental Pollution, Series A, Vol 29, No 4, p 271-302, December, 1982. 8 Fig, 9 Tab, 52 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Metals, *Nitrilotriacetic acid, Wastewater, *Biological wastewater treatment, Municipal wastewater, Industrial wastes.

The removal of nitrilotriacetic acid during sewage treatment is principally by biodegradation. Adsorption of nitrilotriacetic acid onto mixed liquor suspended solids was typically 25%; however, this is considered to unimportant once biodegradation has begun. Prior to the commencement of biodegradation a period of acclimitization is required. It would appear that the nature of the acclimatization period is affected by a number of factors including sludge age, the influent nitrilotriacetic acid concentration and the influent heavy metal concentrations. Acclimatization was most rapid at high sludge ages, low influent nitrilotriacetic acid concentrations and low influent heavy metal concentrations. Acclimatization periods varied between 6 and 25 days. However, in one experiment at a 4-day sludge age no acclimatization was noted after 18 days. Acclimatization occurred when the sludge age was increased to 6 days. To permit the influent heavy metal concentrations to the pilot plant to be partially controlled and to achieve concentrations typical of mixed industrial and domestic sewage, a solution of heavy metals was added to the influent settled sewage in some experiments. The results of jar tests indicate that on a percentage basis these spiked heavy metals are not more readily available for chelation by nitrilotriacetic acid than the idigenous heavy metals, with the possible exception of zinc. (Baker-FRC)
W83-02579

TREATMENT OF UNUSUAL INORGANIC WASTES,
W. Campbell, and M. L. Hemming.
Effluent and Water Treatment Journal, Vol 22, No 10, p 403, 405-406, October, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Industrial wastewater, *Metals, *Chemical wastewater, Latex, Polymers, *Wastewater treatment, Zinc, Inorganic compounds, Organic wastes.

Case histories are described for treatment of several unusual industrial wastes: elastic thread latex, zinc phosphate production wastes, and photo chemicals manufacturing wastes. A latex treatment system was redesigned to alleviate operating problems. Additional coagulation and flocculation tanks were built to relieve hydraulic restriction. The old lime addition system was replaced with a 15% caustic soda dosing system. Other improvements were polyelectrolyte addition, a biofilter, an upward flow clarifier, and sludge dewatering. Final effluent discharged to the sewer contained 4100 mg per liter COD, 2050 mg per liter BOD, and 476 mg per liter suspended solids. A small zinc phosphate plant met effluent standards of $<$ 10 mg per liter Zn and pH 6-9 by sodium carbonate precipitation of wastewater. Wastes from a photo chemicals plant were divided into three streams--solvents (held for tanker collection), ion exchange washwaters (discharged directly to sewer), and general production wastewaters, containing a variety of toxic metal ions and acids. Metal content of the effluent was reduced by precipitation of hydroxides, settlement, and final pH discharge. pH control is automatic. (Cassar-FRC)
W83-02580

ECONOMICS OF PRECIPITANT USE IN MUNICIPAL WASTEWATER TREATMENT PLANTS (WIRTSCHAFTLICHKEIT DES FALLMITTELEINSATZES IN KOMMUNALEN KLARANLAGEN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
U. Neis, B. Geppert, H. H. Hahn, and D. Gleisberg.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 6, p 242-250, June, 1981. 8 Fig, 5 Tab, 17 Ref.

Descriptors: *Wastewater treatment, *Precipitation, *Economic factors, Cost analysis, Purification, Clarification, Water quality.

Precipitation purification is considered as a method for reduction of suspended solids, BOD and COD. A dynamic calculation procedure is used, allowing exact determination of time dependent variation of costs. Results show that waste water treatment costs with precipitation may equal those of conventional primary clarification and secondary biological treatment, especially with low cost iron-II-salts in simultaneous precipitation and in larger plants. In smaller plants cost advantages even result using more expensive trivalent salts in preprecipitation compared to conventional low load biological treatment. This is a consequence mainly of better effluent quality and hence lower waste water fees. If the precipitant is dosed temporarily only during the periods of highest pollution load about 5-10% of the total costs of continuous dosing can be saved. Increasing interest rates and decreasing flocculant costs are favorable for the application of precipitation. Restoration of an overloaded treatment plant by introduction of precipitation can be recommended temporarily at most for 15 years. At longer times immediate construction of a new plant will be more economical. (Baker-FRC)
W83-02591

OXIDATION OF IRON (II) SALTS IN MINE WATERS USING BACTERIA (EISEN (II)-SALZ-OXIDATION IN GRUBENWASSERN MIT BAKTERIEN),
Westfaelische Berggewerkschaftskasse, Bochum (Germany, F.R.).
U. Soboll, G. Rinder, and E. Beier.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 4, p 163-168, April, 1981. 5 Fig, 11 Ref.

Descriptors: *Oxidation, *Bacteria, Thiobacillus ferrooxidans, *Iron oxidation, Nutrients, Phosphates, Cultures, Quartz, Tuffstone, *Mine wastewaters, *Wastewater treatment.

Iron oxidation by Thiobacillus ferrooxidans was investigated in discontinuous and continuous cultures with different packing material (quartz, tuffstone). In preliminary batch tests as many bacteria as possible should be adsorbed on the packing material. It was shown that in cultures with packing material, the oxidation rate was higher than in cultures without packing material. Therefore continuous experiments were conducted only with packing material. Upon using a nutrient-poor, phosphate-free culture medium instead of a nutrient-rich culture medium, the oxidation rate was not lowered. When the concentration of ferrous iron in the feed solution and the feed rate were increased, a corresponding increase in the oxidation rate was noted. At an oxidation rate of 475 mg/1-h(Fe2+) and a concentration drop of ferrous iron from 715 to 1.7 mg/1, the retention time of the solution in the reaction tube was 1.5 hr. There was not much difference in oxidation rate in cultures with different packing materials. In continuous cultures 75% of the formed ferric iron remained in solution at pH 2.5. (Baker-FRC)
W83-02592

FLUSHING AND SHUTOFF DEVICES FOR SEWERS (SPUL- UND ABSPERRORGANE FUR ABWASSERKANALE),
Stadtentwasserungsamt, Frankfurt am Main (Germany, F.R.).
P. H. Hanitsch.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 7, p 356-361, July, 1982. 10 Fig.

Descriptors: *Sewer systems, *Maintenance, Cleaning, Waves, Surges, *Flushing, Equipment.

Sedimentation of solids and sand occurs in sewers with little descent. These accumulations must be removed repeatedly during operation of the sewer. The easiest method of cleaning is to flush sediments by the power of a water wave. There are special flushing devices available to produce such water waves. The larger the sewers and the smaller the descent, the more troublesome is construction and installation of flushing devices. Furthermore if there is only a small distance between sewer-head and surface, special constructions of flushing devices have to be considered. Specifics of construction and operation of several of these special flushing and accompanying shut-off devices are considered. (Baker-FRC)
W83-02619

ENGINEERS ASSESS AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT - PART II,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, R. K. Bastian, and W. J. Jewell.
Civil Engineering (New York), Vol 52, No 11, p 51-53, November, 1982. 1 Fig.

Descriptors: *Wastewater treatment, *Aquaculture, Polycultures, Hyacinths, Duckweed, Ponds, Algae, Biological wastewater treatment.

An engineering assessment of the feasibility for routine use of aquaculture technologies for wastewater treatment is examined. The detailed assessments were conducted by six internationally recognized engineers. The use of combined systems for treatment was of primary concern. The study demonstrated that finfish were effective in providing further treatment in wastewater treatment ponds. Their major role seemed to be suspended solids control for final polishing. It did not appear that aquaculture components in combined systems can be optimized for both protein or biomass production and waste treatment in the same unit. Systems involving higher forms of animals seemed less efficient, required more land area or were more difficult to control than systems primarily based on plants. It is suggested that development of new concepts in the use of polyculture or combined systems for wastewater treatment should be encouraged. (Baker-FRC)
W83-02649

START-UP AND OPERATION OF AN OXYGEN-ACTIVATED ADVANCE WASTEWATER TREATMENT SYSTEM,
Western Lake Superior Sanitary District, Duluth, MN.
J. A. Johnson.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 451-456, April, 1981. 2 Fig, 4 Tab.

Descriptors: *Advanced wastewater treatment, *Oxygenation, *Activated sludge process, *Wastewater treatment, Lake Superior Sanitary District, Duluth, *Minnesota, Unox system, Sludge thickening, Filtration, Clarifiers.

Experiences and problems encountered during the start-up of the Western Lake Superior Sanitary District advanced wastewater treatment facility at St. Louis Bay, Duluth, Minnesota, are described. The facility, designed to treat 6948 cu m per hour of mixed municipal and industrial wastewater, uses a Unox system made of 4 parallel oxygenation trains, total volume 18,500 cu m. Here degritted wastewater is contacted with high purity oxygen through agitation. The process also features clarification, phosphorus removal, filtration through mixed media, chlorination with sulfur dioxide neu-

tralization, and post aeration. Effluent quality complies with the specified 25 mg per liter BOD, 30 mg per liter suspended solids, and 1 mg per liter total P. The cryogenic oxygen generators have functioned well since the September 1978 start-up. The grit tanks have produced a material more like primary sludge than clean, dry grit. This has caused problems, especially spillage from the conveyor and trucks. Other problems included overloading in the sludge dewatering system, unequal distribution of solids among the 4 secondary clarifiers, condensation of water and fog on the aluminum domes covering equipment, malfunctions in the mixed media filtration valve system, chlorine leaks, inexperience with the air flotation thickening units and vacuum filters, and electronic and installation difficulties with the computer control system. Average effluent quality has been 18 mg per liter BOD and 17 mg per liter total suspended solids in spite of highly variable influent (85-720 mg per liter BOD and 64-562 mg per liter suspended solids) and considerable sewer infiltration/inflow in rainy weather. (Cassar-FRC)
W83-02680

DIRECT FILTRATION: POLYMER IN BACKWASH SERVES DUAL PURPOSE,
Pratt Inst., Brooklyn, NY.
C. Yapijakis.
Journal of the American Water Works Association, Vol 74, No 8, p 426-428, August, 1982. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Pilot plants, *Polymers, *Filtration, *Polyelectrolytes, *Backwash, Electrolytes, Water treatment, Pretreatment of water, Turbidity, Sedimentation, Settleable solids, Drinking waters, Costs, New Jersey, Newark.

Pilot plant tests on the addition of anionic polyelectrolytes to backwashing water during direct filtration are described. At a Newark, New Jersey 100 mgd water treatment plant, the effect of preconditioning on initial turbidity breakthrough (ITB) was demonstrated. Nonionic polymer was added to the backwash and reduced the relative ITB duration by 50% to about 15 to 30 minutes. Jar tests indicated that increasing the polymer dose above 50 micrograms/liter should be based on minimizing turbidity breakthrough at the beginning of filter runs rather than on the polymer's effect on the settling ability of the wastewater solids. The addition of the polymer resulted in improved settling of the backwash solids. The complication and cost of adding the polymer is minimal when compared with the benefits. These benefits include possible capital and operational cost savings. (Small-FRC)
W83-02683

TREATMENT OF DRINKING WATER CONTAINING TRICHLOROETHYLENE AND RELATED INDUSTRIAL SOLVENTS,
Environmental Protection Agency, Cincinnati, OH.
O. T. Love, Jr., and R. G. Eilers.
Journal of the American Water Works Assoication, Vol 74, No 8, p 413-425, August, 1982. 22 Fig, 10 Tab, 49 Ref.

Descriptors: *Pilot plants, *Trichloroethylene, *Aeration, *Adsorption, *Organic solvents, Solvents, Water pollution, Water treatment, Activated carbon, Resins, Tetrachloroethylene, Dichloroethylene, Carbon tetrachloride, Dichloroethane.

The effectiveness of various treatment processes for the removal of trichloroethylene and related industrial solvents was evaluated in laboratory and pilot-scale studies. Pilot-scale diffused air aeration studies, pilot-scale granulated carbon and granulated synthetic resin columns, and boiling studies are described. When aeration was used to remove trichloroethylene, it and other solvents were removed. Adsorption was most effective when preceded by aeration. Boiling can remove solvents at point of use, but at least five minutes of vigorous boiling is needed. Preliminary cost estimates varied significantly with treatment process and contaminants. Estimates can only be made with thorough organic analysis and site-specific performance data. Data on the characteristics of the following compounds are given: trichloroethylene, tetrachchloroethylene, 1,1,1-trichloroethylene, cis-1,2-dichloroethylene, carbon tetrachloride, and 1,2-dichloroethane. (Small-FRC)
W83-02685

PROMOTION OF NEW TECHNOLOGIES OF WASTEWATER AND SLUDGE TREATMENT BY THE FEDERAL MINISTRY FOR RESEARCH AND TECHNOLOGY (FORDERUNG NEUER TECHNOLOGIEN DER ABWASSER- UND SCHLAMMBEHANDLUNG DURCH DAS BUNDESMINISTERIUM FUR FORSCHUNG UND TECHNOLOGIE),
Bundesministerium fuer Forschung und Technologie, Bonn-Bad Godesberg (Germany, F.R.).
E. Abel.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 165-166, May/June, 1981. (No English Summary).

Descriptors: *Wastewater treatment, *Sludge, *Research priorities, *Government supports, *Water supply development, Technology, Economic aspects, *Federal Republic of Germany, International commissions, United Nations, Industrial wastewater, Water pollution control, Water shortage, Government finance, Developing countries.

The aims and achievements of the Federal Republic of Germany's (FRG) promotional program, 'New Technologies for Wastewater and Sludge Treatment,' are discussed. The program was set up in 1976 by the Federal Ministry for Research and Technology (FMRT) to aid in the development of methods and procedures required to achieve the federal government's water-quality goals. Areas selected for intensified promotion were water protection and exploitation of the self-cleaning capacity of waters, treatment of industrial wastewater, wastewater-reduction techniques and circulation closure, and sludge treatment and use. Within the program, approximately 160 projects with a mean cost of approximately 135 million Dm have been carried out, about 25% by municipalities and research institutions and about 50% by industrial companies. New procedures have been developed and large demonstration plants constructed. Future research should concentrate on such subjects as techniques to be added to the so-called full biological treatment, treatment of concentrated wastewaters, reduction of energy requirements in wastewater treatment, further development of physical/chemical procedures, and treatment for recycling wastewater. Despite government spending cuts, the FMRT is prepared to finance these efforts. Research into preventive measures such as new industrial methods that produce little or no wastewaters must be promoted. (Gish-FRC)
W83-02716

EVALUATION OF BIOLOGICAL ACTIVATED CARBON INDUSTRIAL WATER REUSE,
Jacobs Engineering Group, Inc., Pasadena, CA.
M. Schwartz, R. G. Rice, and A Benedek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191957, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, OWRT/RU-82/6, December 1982. 105 p, 35 Fig, 20 Tab, 26 Ref. OWRT C-80240-R(No 8805)(1), 14-34-0001-8805.

Descriptors: *Water reuse, *Activated carbon, *Biological treatment, *Ozonation, *Adsorption, *Biodegradation, Chemical oxygen demand, Biochemical oxygen demand, Oxygen uptake, Tertiary wastewater treatment, *Biological activated carbon filters, *Total organic carbon, Adsorption isotherms, Adsorption kinetics, Respirometry, Refinery effluent, Textile effluent, Pulp effluent, Fungicide effluent.

The Biological Activated Carbon (BAC) technology was tested for the production of reusable water, low in organics concentration, from industrial wastewater. Effluent streams from an oil refinery, a pulp mill, a textile dyeing mill, and a fungicide plant were studied. The batch-scale experimental plan used included the step-wise technique of ozonation, respirometric biodegradation, and activated carbon adsorption isotherms and kinetics. This technique simulates the individual processes comprising the BAC technology. A follow-up experimental plan included continuous-flow short column granular activated carbon (GAC) tests which simulate a BAC system. The test results showed that, relative to unit ozone dose, both ozonation and biodegration were more effective at a lower ozone dosage, in the ratio of 0.10 sub 3 to 1 TOC. The cumulative results of the ozonation and biodegradation tests showed that, except for the refinery effluent, optimum TOC reduction was obtained at the lower ozone dosage. TOC reduction in the refinery effluent increased with an increase in the ozone dose. The isotherm studies showed that the ultimate adsorption capacity of the carbon at equilibrium with the influent TOC concentration was enhanced by up to 50% when the effluents were susceptible to biodegradation. Overall analysis of the test results for each of the four industrial wastewater streams has indicated that the fungicide wastewater was not a good candidate for BAC treatment, that the oil refinery wastewater was potentially a good candidate for BAC treatment, and that only segregated streams from the pulp mill and textile dyeing mill wastewaters can be considered as candidates for BAC treatment.
W83-02742

OPTIMIZATION OF NITROGEN REMOVAL IN THE SINGLE SLUDGE ACTIVATED SLUDGE PROCESS,
Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering.
A. C. Van Haandel, P. L. Dold, and G. V. R. Marais.
Water Science and Technology, Vol 14, No 6/7, p 443-461, 1982. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Nitrogen removal, *Activated sludge process, Sludge, Design criteria, Temperature effects, Sludge age, Chemical oxygen demand, *Optimization.

An optimization procedure is presented which allows rational selection of the process configuration and oprational parameters to achieve maximum removal of nitrogen in a single sludge N-D system, within the constraints set on the system. Under constant flow and load conditions simple and approximate but highly accurate formulae are developed to describe the N-D system. Selection of the N-D configuration is crucially influenced by the TKN/COD (influent) ratio, maximum and minimum temperatures and sludge age. In terms of these factors design charts presented which rapidly allow the best configuration and sizes of the anoxic and aerobic reactors to be selected. The maximum and minimum temperatures can be readily assessed from full-scale plants in the region and TKN/COD ratios by direct measurement. Determination of the easily biodegradable sewage fraction and the reference maximum specific growth rate of nitrifiers will preesent the greatest difficulty, as these can be determined only by process equipment. (Baker-FRC)
W83-02746

BIOLOGICAL NITRIFICATION IN AN UP FLOW FIXED BED REACTOR (UFBR),
Societe Degremont, Rueil-Malmaison (France). Dept. de Recherches Biologiques.
G. -M. Faup, A. Leprince, and M. Pannier.
Water Science and Technology, Vol 14, No 8, p 795-810, 1982. 9 Fig, 4 Tab, 10 Ref.

Descriptors: *Nitrifivation, *Model studies, *Wastewater treatment, Biological wastewater treatment, Activated sludge, Kinetics, Biomass, Nitrogen, *Ammonification, Ammonia, Municipal wastewater.

A kinetic model is described for ammonifiction and nitrification in an upflow fixed bed reactor with direct injection of air into the support material. Modeling has been based on the computation of active biomas concentration along the reactor. The tests, which extended over a period of one year and have been applied to municipal sewage after conventional treatment using activated sludge,

have shown that the filtration rate is the most important factor regarding both the overall quantity of biomass found in the system and the distribution of this biomass within the reactor. The optimum quantity of biomass is obtained with a filtration rate of about 5 cu m per sq m per hr. Under these conditions it is possible to reach active biomass concentrations 8 to 9 times higher than the ones found in conventional processes based on the use of nitrifying activated sludge. It is also clearly evidenced that ammonification will in most cases be incomplete, and this will limit the efficiency of the overall reaction of total N to nitrate. (Baker-FRC)
W83-02747

MASS-TRANSFER CHARACTERISTICS WITHIN MICROBIAL SYSTEMS,
Iwate Univ., Morioka (Japan). Dept. of Civil Engineering.
M. Onuma, and T. Omura.
Water Science and Technology, Vol 14, No 6/7, p 553-568, 1982. 16 Fig, 4 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Microbial degradation, *Mass transfer, *Diffusion coefficient, Biofilms, Viscosity, Kinetics.

The diffusion coefficient within a microbial system was determined by both diffusion and kinetic studies on the basis of Fick's model and an effectiveness factor model in order to predict the mass-transfer characteristics of this system. It was found to be dependent on the molar weight and the C/N ration of the compounds and substrates used in the diffusion study. On the other hand, the transitional film thickness from a reaction limited case to a diffusion limited one was found to be about 150 microns in a kinetic study. The observed diffusion coefficient in the diffusion study was of the same order as that of the kinetic study. (Baker-FRC)
W83-02749

THE SCALE-UP AND LIMITATION OF PHYSICAL OXYGEN TRANSFER IN ROTATING BIOLOGICAL CONTACTORS,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
B. -J. Kim, and A. H. Molof.
Water Science and Technology, Vol 14, No 6/7, p 569-579, 1982. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Oxygen transfer, *Biological wastewater treatment, *Rotating biological contactors.

Three different sized laboratory scale Rotating Biological Contactor (RBC) units were constructed to study the controlling factors of physical oxygen transfer. Physical parameters were identified and evaluated by the volumetric oxygen transfer coefficient from non-steady state clean water tests. The controlling factor was found to be the liquid film flow rate per unit volume, and the function could be practically expressed and is given. The turbulence effect on the free water surface and subsurface volume became comparatively less significant as the disk size increased. The data indicated that the physical oxygen transfer contribution to the biological treatment oxygen requirement became less significant than oxygen transfer through other mechanisms as the disk size increased. This may be explained by a direct absorption of oxygen by the microorganisms. (Baker-FRC)
W83-02750

A NEW CONFIGURATION OF THE HIGH-LIME PROCESS WITH SLUDGE RECIRCULATION FOR MAGNESIUM RECYCLING,
Arizona Water Resources Research Center, Tucson.
E. Idelovitch, and A. M. Wachs.
Water Science and Technology, Vol 14, No 6/7, p 655-673, 1982. 9 Fig, 7 Tab, 10 Ref.

Descriptors: *Activated sludge process, *Advanced wastewater treatment, *Wastewater treatment, Sludge, Lime sludge, Magnesium recycling, *Sludge conditioning.

Laboratory experiments carried out with lime-algae sludge and low magnesium effluent showed that magnesium can be recycled in the high lime process by sludge recirculation. By mixing sludge with effluent, a pH of about 9 is achieved, which ensures partial dissolution of magnesium hydroxide to magnesium carbonate and magnesium bicarbonate. After settling of the sludge, the effluent enriched with Mg can be conveyed to lime treatment, whereas the new sludge can be dewatered more economically than the original sludge. The clarification results obtained with recycled Mg by sludge recirculation are similar to those obtained with MgCl2 and with recycled Mg by means of CO2, but lime consumption is lower, since part of the effluent alkalinity is consumed in the process of Mg dissolution. No dissolution of boron or heavy metals occurs, but part of the colloidal organic matter and phosphorus are released from the sludge. By means of simple computer programs that were prepared, it is possible to determine the total Mg concentration that can be reached by recycling, as well as to forecast the increase in the concentration of the dissolved and suspended fractions of any substance at steady state conditions. There is no danger of substances accumulating to undesirable levels in the final effluent. An economic evaluation showed that the new configuration of the high-lime process with sludge recirculation facilitates the solution of the sludge problem, eliminates the need for Mg addition from external sources, and reduces considerably the process cost. (Baker-FRC)
W83-02751

EFFECT OF DENITRIFICATION ON THE PH IN BIOFILMS,
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
E. Arvin, and G. H. Kristensen.
Water Science and Technology, Vol 14, No 8, p 833-848, 1982. 8 Fig, 4 Tab, 11 Ref.

Descriptors: *Denitrification, *Hydrogen ion concentration, *Biofilms, *Wastewater treatment, Nitrates, Carbon dioxide, Bicarbonates, Kinetics, Alkalinity, Diffusion coefficient.

Experiments performed in a laboratory fixed film unit (rotating drum biofilm reactor) showed that the pH's inside the biofilm were as much as 1.7 units greater than the pH's of the bulk liquid. This phenomenon was ascribed to production of alkalinity and the diffusional resistance to transport of alkalinity out of the biofilm. Greatest differences in pH were produced by a high bulk liquid pH, low alkalinity, a deep active biofilm, and small effective diffusion coefficients for bicarbonate and carbonate ions. The experimental results agreed with results from a model developed to describe the pH profile in a denitrifying biofilm. In the biofilm the average values of diffusion coefficients for nitrate, carbon dioxide, and bicarbonate were reduced to 65%, 30%, and 52%, respectively, of the values in pure water. The intrinsic reaction rate of nitrate was 0.23-0.42 g per cu m per sec. (Cassar-FRC)
W83-02752

OBTAINING SECONDARY TREATMENT WITH RBC/UNDERFLOW CLARIFIERS,
Bogert (Clinton) Associates, Fort Lee, NJ.
I. L. Bogert.
Water Science and Technology, Vol 14, No 6/7, p 429-442, 1982. 9 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Clarification, Secondary wastewater treatment, Baffles, Biological wastewater treatment, *Rotating biological contactors, New Jersey, Edgewater.

A one-year experimental program conducted at Edgewater, New Jersey evaluated the concept of providing secondary wastewater treatment through the installation of rotating biological contactors (RBCs) in modified primary sedimentation tanks. A primary tank was divided horizontally into two zones separated by an intermediate floor. Four RBCs were placed in the upper zone. The lower zone provided secondary sedimentation. High rate primary sedimentation was provided to remove grit and trash without removing substantial portions of BOD and SS. The experimental program was conducted over a full year at different loads, and appeared to provide effective secondary treatment with little difference in treatment efficiency between summer and winter conditions. The process was able to realize 30 mg/1 total BOD5 and TSS or 85% total BOD5 and TSS removal, whichever provided the greater degree of treatment. Pretreatment of the raw wastewater was needed throughout the study period to remove grit, trash and floatables. Tracer analyses indicated that each RBC stage, as defined by baffle placement, behaved as a completely mixed tank. The overall organic removal efficiency was limited by oxygen availability, as determined by use of an RBC mathematical kinetic model. (Baker-FRC)
W83-02753

SIMULATION OF NITRIFICATION AND ITS DYNAMICS IN A ROTATING BIOLOGICAL CONTACTOR,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
Y. Watanabe, H. E. Bravo, and K. Nishidome.
Water Science and Technology, Vol 14, No 8, p 811-832, 1982. 21 Fig, 4 Tab, 14 Ref.

Descriptors: *Biological treatment, *Nitrification, *Kinetics, *Wastewater treatment, *Rotating biological contactors, Ammonia, Model studies, *Biofilms, Nitrous acid, Dissolved oxygen.

Nitrification in a partially submerged rotating biological contactor was simulated by computer. Several conclusions were reached. Although the ammonia and dissolved oxygen concentrations changed with the biofilm spatial position, the average mass flux to the biofilm surface was similar in model and experimental results. A pseudo-steady-state condition was established in the diffusion layer and in the biofilm with respect to the bulk liquid ammonia concentration during the transient period of operation. At very high ammonia concentrations process instability occurred as a result of substrate and product inhibition from free ammonia and nitrous acid. The model should include the tendency of the products to accumulate in the system and to poison the biofilm. (Cassar-FRC)
W83-02754

A MATHEMATICAL MODEL OF BIOLOGICAL PURIFICATION IN AERATED ACTIVATED CARBON BIOFILTERS,
Ecole Nationale Superieure de Chimie de Rennes (France).
G. Martin, A-Y. Le Roux, and P. Schulhof.
Water Science and Technology, Vol 14, No 6/7, p 599-618, 1982. 7 Fig, 2 Tab, 30 Ref.

Descriptors: *Model studies, *Purification, *Filters, *Wastewater treatment, Biofilms, Mathematical studies, Mathematical equations, Carbon biofilters, Biological treatment, *Activated carbon, Bacteria, Adsorption.

On the basis of results obtained in the laboratory and in a semi-industrial pilot plant, this paper outlines the probable mechanism of biological purification on activated carbon. It shows that with small loads, the medium's porosity plays a permanent role in the treatment of a water. The biological activity which develops on the material acts in a complementary fashion, allowing for continuous regeneration of the pores of the activated carbon. With heavy loads, there are two phases. During the first, adsorption and biological regeneration are complimentary. This phase lasts three to four hours. During the second phase, development of the biomass obstructs the occurrence of the adsorption phenomenon. Substrate is removed on the surface. This second phase lasts from 15 to 20 hr until the filter is clogged. After washing, the first phase again enters into operation. A mathematical model is presented. It describes results obtained with small and heavy loads. The model presents a good correlation between experimental and computed values, and manifests the advantage of using activated carbon when the influent to be treated contains adsorbable and biodegradable substances. (Baker-FRC)
W83-02755

THE FATE OF SOME METAL SPECIES: LEAD, CADMIUM, ZINC IN SURFACE WATER, DURING BIOLOGICAL SAND FILTRATION - EFFECT OF PREOZONATION,
Institut Pasteur de Lille, Villeneuve d'Ascq (France).
F. Erb, D. L. Delabre, J. C. Hopitault, A. Philippo, and P. Thomas.
Water Science and Technology, Vol 14, No 6/7, p 641-653, 1982. 5 Fig, 4 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Filtration, *Metals, Lead, Cadmium, Zinc, *Preozonation, Speciation, *Ozonation, Biological treatment, Humic acids, Chelation, Biological filters, Sand filters.

The elimination of the different chemical species of some toxic metals was determined. These metals include zinc, lead, and cadmium; their elimination was investigated during biological sand filtration on surface water containing humic material which is able to promote the complexation of metals. The effect of preozonation was examined. The metal speciation was realized by means of atomic absorption spectrometry and differential pulse anodic stripping voltammetry. The survey of organic matter was carried out by measuring TOC, UV absorption and fluorescence. The biological treatment of raw water is quite effective for the removal of particulate metals. The data bring out an important decrease for dissolved metals - about 50 to 60% with cadmium and lead - especially noteworthy for the labile complexed metals. The preozonation of raw water provides the redissolution of particulate cadmium and zinc, which are converted to free metals and seem then to be further eliminated by biological filtration. Ozonation appears to improve the efficiency of biological treatment, which usually gives higher yields of purification than flocculation (aluminum sulfate) in the same conditions. (Baker-FRC)
W83-02756

THE USE OF RHEOLOGY FOR SLUDGE CHARACTERIZATION,
Canada Centre for Inland Waters, Burlington (Ontario).
H. W. Campbell, and P. J. Crescuolo.
Water Science and Technology, Vol 14, No 6/7, p 475-489, 1982. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Sludge, *Rheology, Anaerobic digestion, Chemical analysis, Viscosity, Measuring instruments, Stress.

Rheological measurements were conducted on a variety of anaerobically digested sewage sludges to evaluate the potential use of rheology in describing the effects of chemical conditioning on the physical characteristics of sludges. The study was designed to evaluate the influence of the method of chemical conditioning on rheological measurements, to determine the response of the viscometer system to changes in the instrument variables, and to evaluate interrelationships between rheology and other physical properties. All rheological measurements were made using a coaxial rotational viscometer. Evaluation of a variety of test procedures indicated that both the method of adding chemical conditioners and the acceleration rate of the rotational viscometer could significantly alter the shape of the rheograms. A suggested methodology was identified, and selected samples were analyzed in triplicate to test the reproducibility of the procedures. Existing material models do not adequately describe the variety of flow behavior patterns observed with sewage sludge. The concepts of yield stress and apparent viscosity also have limited value. A parameter termed the instantaneous viscosity, defined as the derivative of the flow curve, is suggested as being more suitable for describing sludge behavior. The relationships between chemical conditioning, particle size distribution and applied shear were explored. As polymer addition increased, the sludge particles became more susceptible to shear breakup. The extent of particle size reduction depended on the rate of shear and the time during which the shear was maintained. (Author's abstract)
W83-02757

ROLE OF BACTERIAL EXTRACELLULAR POLYMERS IN METAL UPTAKE IN PURE BACTERIAL CULTURE AND ACTIVATED SLUDGE-I. EFFECTS OF METAL CONCENTRATION,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. J. Brown, and J. N. Lester.
Water Research, Vol 16, No 11, p 1539-1548, November, 1982. 10 Fig, 1 Tab, 27 Ref.

Descriptors: *Heavy metals, *Adsorption, *Klebsiella, Activated sludge, *Activated sludge process, *Separation techniques, *Chelating agents, Cadmium, Nickel, Manganese, Cobalt, Sewage bacteria, Polymers, Wastewater treatment, Fate of pollutants.

The amount of metal adsorbed by cells of Klebsiella aerogenes and flocs in the activated sludge process before and after extracellular polymer extraction was examined to determine the role of bacterial extracellular polymers in metal uptake. A gel filtration technique provided good separation of metals (Co, Ni, Mn, and Cd) complexed with bacterial extracellular polymers and free metal ions. The extraction of extracellular polymers from cultures of K. aerogenes and activated sludge reduced the capacity of cells and flocs to adsorb metal. The adsorption and complexation of metals by cells and extracellular polymers were fitted to Freundlich equilibrium isotherms. Saturation of activated sludge polymer binding sites occurred at 10 milligrams/liter metal additions (except for Mn), while K. aerogenes cells showed no saturation effects in the range of metal concentrations tested. At concentrations of 10 milligrams/liter for Cd, Co and Mn, precipitation may have been the main mechanism of metal removal. The more soluble metals generally displayed the lowest removals. The levels of extracellular polymers and soluble chelating agents in activated sludge may be important in affecting the removal of metals. (Geiger-FRC)
W83-02767

SUPERBUGS: BACTERIA FOR WASTEWATER TREATMENT PLANTS,
Williamsport Sanitary Authority, PA. Wastewater Div.
M. H. Gerardi.
Public Works, Vol 113, No 12, p 37-38, December, 1982. 10 Ref.

Descriptors: *Bacteria, *Organic wastes, *Biological treatment, Wastewater treatment, Sewage bacteria, Cultures, Micoorganisms, Digestion, Process control, Bioaugmentation.

The efficiency of organic wastewater treatment systems may be enhanced by adding cultures of selected or mutant bacteria. These bacterial suspensions are available from several commercial sources. They typically contain Aerobacter, Bacillus, Cellulomonas, Nitrobacter, Nitrosomonas, Pseudomonas, and Rhodopseudomonas, which degrade larger organic molecules into smaller molecules which then can be metabolized by other bacteria. To use cultures in a wastewater system, the specific conditions and problems must first be assessed and appropriate bacterial types and quantities determined. Bacteria are added daily in a water suspension (0.5-2 gal per 1 million gal raw sewaga) after the grit removal step. Improvement is generally seen in 30-90 days and lasts about 60 days after ending bacterial addition. Bioaugmentation can control foam, hydrogen sulfide, ammonia, undesirable bacteria, and odor; improve BOD and suspended solids removal, cold weather performance, digester gas production, and sludge settleability; correct a sour digester; and buffer the effects of shock and toxic loads. (Cassar-FRC)
W83-02769

WASTEWATER SYSTEM IMPROVEMENTS HELP DALLAS MEET FUTURE NEEDS,
Camp, Dresser and McKee, Inc., Dallas, TX.
W. B. Buchholz, and P. A. Roach.
Public Works, Vol 113, No 12, p 52-53, December, 1982.

Descriptors: *Activated sludge process, *Sludge digestion, *Wastewater treatment, Dallas, *Texas, Sewers, Trickling filters, Digestion, Planning.

A capital and operating improvement program for Dallas, Texas, was designed to meet needs through the year 2000. The present system includes a 115 mgd activated sludge-trickling filter plant and a 30 mgd activated sludge facility which currently treat 156 mgd. Flow in 2000 is expected to reach 195 mgd. The most economical alternative was to rehabilitate and expand the two existing plants to 210 mgd capacity. It was recommended that relief interceptors be constructed immediately to handle peak flows in critical sections. Other projected improvements were construction of relief sewers for four major interceptors, diversion of two existing interceptors to balance flow to each plant, institution of infiltration/inflow studies on a 5-year cycle, change of single-stage operation in the trickling filter plants, addition of secondary clarifiers and multimedia filters, installation of new activated sludge units with appurtenances, and gravity thickening of sludge followed by anaerobic digestion and land disposal. The use of methane gas produced in the sludge digestion process will save about $7 million annually in energy costs. (Cassar-FRC)
W83-02771

EFFECTIVE START-UP TRAINING FOR WASTEWATER TREATMENT PLANTS,
Onondaga County Dept. of Drainage and Sanitation, Syracuse, NY.
R. R. Metcalf.
Public Works, Vol 113, No 12, p 49-50, December, 1982. 1 Tab.

Descriptors: *Training, *Personnel, *Process control, *Wastewater treatment, Plants, Operating policies, Maintenance, Scheduling.

For effective training during wastewater plant startup, the owner must start planning before the contract stage. All aspects of training desired from manufacturer's representatives must be specified. Adequate time must be allotted for each phase of instruction. Training time must be separate from the final adjustment period. Equipment suppliers should include the following training: proper installation of equipment, routine and emergency startup and shutdown procedures, routine operation and maintenance, and basic troubleshooting. Instruction in basic treatment processes should be provided for new personnel and reviewed for experienced personnel before the manufacturer's training programs. A sample schedule is given in a table. It is designed to provide an orderly sequence and a minimum of overlap in subjects. The most critical processes were scheduled early in the 10-month program. (Cassar-FRC)
W83-02772

DYNAMICS OF PHOSPHORUS AND NITRATE REMOVAL FROM PARTIALLY PURIFIED WASTE WATERS OF PIG BREEDING FARMS BY MEANS OF ISOLATE CULTIVATIONS FROM THE GENERA CHLORELLA AND SCENEDESMUS (DINAMIKA NA OTSTRANYAVANE NA FOSFOR I NITRATI OT CHASTICHNO BIOLOGICHNO PRECHISTENA OTPADUCHNA VODA OT SVINEKOMPLEKS PRI KULTIVIRANE NA IZOLATI OT RODOVETE CHLORELLA I SCENEDESMUS),
Bulgarian Academy of Sciences, Sofia. Nauchno-Proizvodstvena Lab. po Algologiya.
K. M. Benderliev, H. V. Dilov, and N. V. Cherkezov.
Khidrobiologia (Sofia), Vol 13, p 39-45, February, 1981. 5 Tab, 14 Ref. (No English summary.).

Descriptors: *Animal wastes, *Phosphorus, *Nitrate, Algae, *Wastewater treatment, *Chlorella, *Scenedesmus, Biological treatment, Productivity, Phosphates, Nitrates.

The productivity of eleven isolates from the genera Chlorella and Scenedesmus acutus and three mixed samples of Chlorella sp and Scenedesmus sp was studied in partially purified waste water from pig farms. The study measured the

daily removal rates of total phosphorus, inorganic phosphates and nitrates. The highest percentage of removal for all isolates occurred during the first 24 hours of cultivation. The fresh cultures accumulate 2 to 7 times more phosphorus than those in steady state. Under conditions where the pH is between 7.1 and 7.3 during the first 24 hours, not more than 40% of the phosphorus and up to 90% of the nitrate are removed from the waste waters. The best results were obtained with 1/1 mixtures of Chlorella sp and Scenedesmus sp. For control of phosphorus in this type of wastewater, chemical treatment is recommended. It is suggested that if an algalbacterial suspension were supplied instead of potable water, no nitrate toxicity problem could arise. (Baker-FRC)
W83-02773

5E. Ultimate Disposal Of Wastes

EFFLUENT LIMITATIONS BASED ON WATER QUALITY,
Delaware State Dept. of Natural Resources and Environmental Control, Dover. Water Resources Section.
R. J. Touhey, and G. L. Esposito.
Public Works, Vol 113, No 11, p 43-46, November, 1982. 1 Fig, 1 Tab.

Descriptors: *Pollution load, *Effluent limitations, *Water quality control, Wastewater treatment, Lewes, Rehobeth Beach, *Delaware, Model studies, Coliforms, Nutrients, Nonpoint pollution sources, Wastewater disposal, Disinfection, Dissolved oxygen, Oxygen.

Water quality in the Lewes-Rehobeth Canal (Delaware) has limited waste assimilative capacity because of significant nonpoint source loads and limited flushing. Nevertheless, it was chosen as a viable alternative for disposal of effluent from proposed upgraded wastewater treatment plants which will include secondary treatment, filtration, and disinfection. A water quality model for the canal was developed, calibrated, verified, and used to evaluate 10 different discharge scenarios from zero discharge to concentrations similar to discharge of the present primary treated wastewater. Although nitrogen was found to be the limiting nutrient in Rehobeth Bay, there is no need for permit limits at the present time. Coliform levels are a major concern, but little regrowth occurs at the proposed high degrees of treatment and disinfection. Chlorine residuals must be carefully monitored and regulated. Upgrading the treatment to the secondary level will improve dissolved oxygen levels only modestly. A waste load allocation approach will ensure that water quality will not deteriorate below 1973-79 levels. (Cassar-FRC)
W83-02466

THE SEA EFFLUENT PIPELINE - ENVIRONMENTAL BLUNDER OR SOCIO-ECONOMIC BOON.
Civil Engineer in South Africa, Vol 24, No 5, p 188-189, 1982.

Descriptors: *Outfall, *Outfall sewers, *Wastewater outfall, *Industrial wastewater, *Pipelines, Industrial wastes, Conveyance structures, Environmental effects, Water pollution effects, Pulp and paper industry, Fertilizers, Bays, Richards Bay, *South Africa.

The controversy between planners and environmentalists over the Richards Bay proposed sea outfall scheme is discussed. The proposed pipeline will collect industrial and municipal effluents in Richards Bay and discharge them between three and four kilometers out to sea. The pipeline may be necessary in order for industrial development to continue, but it may have a devastating effect on the environment. Initial effluent contributors will be a paper company, a fertilizer company, and the town. Ultimately, 176,100 cu m/day will be discharged (in 2013). All effluents will be subject to conditions determined by the Department of Environmental Affairs in consultation with the South African Bureau of Standards, the Sea Fisheries Institute, and the Department of Health. The strongest justification for the pipeline is socio-economic, as the need to create jobs for KwaZulu's citizens is an important national priority. Environmental studies are planned to assess the effects of the outfall. (Small-FRC)
W83-02517

SLUDGE DISPOSAL IN SOUTHERN CALIFORNIA BASINS,
California Inst. of Tech., Pasadena. Environmental Quality Lab.
G. A. Jackson.
Environmental Science and Technology, Vol 16, No 11, p 746-757, November, 1982. 7 Fig, 11 Tab, 37 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Environmental effects, Marine environment, Organic matter, Model studies, Santa Monica, San Pedro, *California, Sulfides, Nitrates, Trace metals, Metals, Sedimentation, Dissolved oxygen, Oxygen, Particulate matter, Disposal.

A one-dimensional model of physical and chemical processes in the San Pedro-Santa Monica Basin, California, was developed to predict environmental responses to different ocean disposal strategies for digested sewage sludge. Disposal at 600 m or deeper would seriously reduce oxygen concentrations to as low as 1.3 micro M. However, sludge disposal at 400 m would decrease dissolved oxygen levels only slightly. Heavy metals inputs were estimated at 3-9 times present levels. Organic loads would increase by 3.5 times to 9.2 billion mol of 02(BOD) per year. Nitrate reduction in the basin would increase by 56% over present levels. Sulfide buildup is not expected to be significant. The increased amount of particulate carbon and dissolved organic carbon in the basin could change species composition of the faunal communities. (Cassar-FRC)
W83-02527

PRIORITY POLLUTANTS IN MUNICIPAL SEWAGE SLUDGE,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
L. M. Naylor, and R. C. Loehr.
BioCycle, Vol 23, No 4, p 18-22, July/August, 1982. 9 Tab.

Descriptors: *Sludge disposal, *Land application, *Risks, Priority pollutants, Fate of pollutants, Pesticides, Organic compounds, Metals, Chlorinated hydrocarbons, Phenols, Hydrocarbons, Aromatic compounds, Toxicity, Ammonia, Nitrogen compounds, New York.

Concentrations of 24 organic and 7 metallic priority pollutants in undigested combined municipal sludges are listed. Projected land application rates for each pollutant allow selection of an application rate which will avoid excess laoding of toxic materials. Median laodings ranged from 1.2 kg per ha dry weight for bis-2-ethylhexyl phthalate to 0.0027 kg per ha dry weight for benzene. Metals applied at a median loading remain in the soil from 18 to 135 years. Calculated sludge application rates for the 13 sludges investigated were 5-13 (median, 11) tons per acre on a dry solids basis. Cadmium was limiting in only one sludge, copper and zinc were limiting in New York sludges. (Cassar-FRC)
W83-02552

AEROBIC THERMOPHILIC DIGESTION OF SEWAGE SLUDGE,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
H. G. Gunson, and S. F. Morgan.
Effluent and Water Treatment Journal, Vol 22, No 8, p 319-320, August, 1982.

Descriptors: *Sludge digestion, *Wastewater treatment, *Aerobic thermophilic digestion, Sludge disposal, Sludge treatment, Aerobic digestion, Sewage sludge.

A body of experience has been gained handling domestic, agricultural and industrial sludges which confirms that aerobic digestion of sludges at elevated temperatures using air as the oxidant gas can be a viable technique provided that an efficient aeration and mixing system is employed and that due attention is paid to the quality of the sludge and the design of the reactor. The process offers considerable capital cost savings, gives immediate relief from odor, provides an attractive aerobic treated sludge and indicates a route to the longer term goal of pathogen reduction. Failures in earlier systems have been attrributed to use of a weak, intractable sludge or one with an imbalance such that a sufficient flux of heat was not generated; use of a digestor or reaction vessel of shape, size, or in a location such as to mitigate against heat conservation; or the use of an aerator with a low efficiency of oxygen transfer such that the high volume of inactive gases being passed through the digester contents acted as a cooling influence. (Baker-FRC)
W83-02568

BIOMASS OF MARINE MACROFAUNA COMMUNITIES IN A DUMPING AREA OF SEWAGE SLUDGE NEAR THE ELBE ESTUARY (DIE BIOMASSE MARINER MAKROBENTHOS-GESELLSCHAFTEN IM BEMUNDUNG),
Zoologisches Inst. und Museum, Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W83-02627

A PUBLIC POLICY FOR HAZARDOUS WASTES,
Hofstra Univ., Hempstead, NY. School of Law.
For primary bibliographic entry see Field 6E.
W83-02653

THE ROLE OF BENTONITE IN SOIL SEALING APPLICATIONS,
International Minerals and Chemical Corp., Des Plaines, IL.
For primary bibliographic entry see Field 5G.
W83-02662

PROPERTIES OF NEW CHLORAMINE DISINFECTANT AND DETOXICANT,
Auburn Univ., AL. Dept. of Poultry Science.
E. C. Mora, H. H. Kohl, W. B. Wheatley, S. D. Worley, and J. H. Faison.
Journal of Poultry Science, Vol 61, 1982. p 1968-1971, 4 Tab, 16 Ref. OWRT OWP A-072-ALA(3), 14-34-0001-1101.

Descriptors: *Disinfection, Drinking water, Potable water, Treated water, Chemical analysis, Chemical treatment, *Chloramine, Assay, Toxicity, Chickens, Aflatoxin B1, Organic compounds, Alabama, *Wastewater treatment.

A new chloramine disinfectant, 3-chloro-4,4-dimethyl-2-oxazolidinone, was assayed for toxicity in chickens. The compound did not induce detectable toxic effects in chickens when administered in drinking water (200 ppm) for an 8-week period. The compound has a significant pH dependent ability to detoxify aflatoxin B sub 1.
W83-02733

TERRACED PASTURE FOR DISPOSAL OF DAIRY YARD RUNOFF,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. O. Hegg, C. L. Barth, V. L. Quisenberry, and W. H. Livingston.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191940, Price codes: A04 in paper copy, A01 in microfiche. Report No 99, 1982, 42 p, 5 Fig, 6 Tables, 18 Ref. OWRT A-045-SC(1), 14-34-0001-0143.

Descriptors: Runoff, *Animal wastes, *Agricultural wastes, *Agricultural runoff, Rainfall-runoff relationships, Nitrogen, Phosphorus, Pastures, *South Carolina, Animal waste treatment, *Land application, Waste disposal.

An alternative system of handling and disposing of milking barn wastewater and feedlot runoff water

was evaluated for three years. This system was established on a 50-cow dairy farm in south Carolina and consisted of utilizing a pasture areas downslope from a dairy to infiltrate and filter the liquid, nutrients and solids from the milking barn and the diary feedlot runoff water. The pasture was modified by the addition of a spreader terrace and three level terraces to distribute the runoff water. Wastewater discharged from the milking barn typically infiltrated the soil before reaching the terrace system. Several of the small rainstorms produced runoff from the dairy feedlot which was completely infiltrated by the terraced pasture. The concentration of the runoff water leaving the dairy feedlot was reduced by the time it left the terraced pasture, for rains which produced runoff at both weirs, by an average percentage of: NH sub 3 -N, 87; TKN, 88; PO sub 4 -P, 79; COD, 83; TS, 50; total coliform, 79; and fecal coliform, 90. The mass of nutrients was reduced by an average of: NO sub 3 - N, 75; NH sub 3 -N, 69; TKN, 76; PO sub 4; 68; COD, 91 and TS, 14 all as percentages, including rains that produced runoff from the feedlot but not necessarily from the terraced pasture. The system performed very satifactorily. The operator did not have to spend any time or money on the disposal system after the initial preparation of the terraced pasture.
W83-02741

FATE OF HEAVY METALS AND POTENTIAL FOR CLINKER FORMATION DURING PILOT SCALE INCINERATION OF MUNICIPAL SLUDGE,
Canada Centre for Inland Waters, Burlington (Ontario).
H. W. Campbell, P. J. Crescuolo, and T. R. Bridle.
Water Science and Technology, vol 14, No 6/7, p 463-473, 1982. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Incineration, *Heavy metals, *Sludge, Sludge disposal, Municipal wastewater, Wastewater treatment, Mercury, Lead, Arsenic, Cadmium, Silica, Chromium, Copper, Aluminum, Nickel, Iron, Zinc, Phosphorus, Ontario.

Pilot scale investigations were conducted at the Hamilton, Ontario Water Pollution Control Plant (WPCP) by the Wastewater Technology Centre during the period from July 1976 to May 1977 using a six-hearth natural gas fired sewage sludge incinerator. The study was made to determine under controlled conditions the fate of a selected number of elements within the normal ranges of operating parameters or a multiple-hearth incinerator handling municipal sewage sludge and to determine the optimal and/or boundary conditions of temperature, throughput capacity and center shaft speed with regard to the prevention of clinker formation while minimizing the residual organic content of the incinerator ash. Phosphorus, zinc, iron, magnesium, aluminum, nickel, copper, calcium, chromium, lead and silica remained in the ash. The degree of cadmium volatilization was a function of the temperature, ranging from a loss of cadmium in the ash of 25% at 760C to 56% at 928C. Arsenic was classified to the gas stream but not discharged to the atmosphere. More than 99% of the mercury was classified to the gas stream under all operating conditions. It was concluded that Hamilton WPCP sludge could be incinerated in the pilot study unit without clinker formation at temperatures up to 928C provided the residence time was minimized. The destruction of total carbon was essentially complete over the entire range of operating conditions studied. The minimum level of destruction achieved was 98.7%. (Baker-FRC)
W83-02789

APPLICATION OF THE MARAIS - EKAMA ACTIVATED SLUDGE MODEL TO LARGE PLANTS,
Johannesburg City Health Dept. Lab. (South Africa).
H. A. Nicholls.
Water Science and Technology, Vol 14, No 6/7, p 581-598, 1982. 8 Fig, 7 Tab, 6 Ref.

Descriptors: *Model studies, *Wastewater treatment, *Activated sludge process, Marais-Ekama model, Nutrients, Oxygen consumption, Sludge thickening, Sludge conditioning.

The Marais-Ekama model describes the behavior of most activated sludge systems by predicting the effluent quality, oxygen consumption and sludge concentration produced. This model was used to successfully predict the performance of two 50,000 cubic meter/d five-stage nutrient removing activated sludge plants. The experimental data used to test the model was obtained by monitoring the feed, effluent and contents of each reactor in the process, every two hours for 4 days. In addition, a respirometer was developed to measure the oxygen utilization rate automatically every 30 minutes. All data collected was found to be valid, as acceptable COD and nitrogen balances across the plants were possible. The data was then compared with the steady state and unsteady state responses of the model. It was found that the model could successfully predict the COD, TKN, ammonia and nitrate concentrations in the effluent and illustrate some shortcomings in the process layouts. This indicated that the model could be used by designers and operators of large scale plants to predict performance and highlight problem areas. (Baker-FRC)
W83-02791

5F. Water Treatment and Quality Alteration

DESIGN OF THE LOS ANGELES AQUEDUCT WATER FILTRATION PLANT,
Los Angeles City Dept. of Water and Power, CA.
D. G. McBride, P. W. Prendiville, and M. G. Hoover.
Public Works, Vol 113, No 11, p 36-38, November, 1982. 2 Fig.

Descriptors: *Filtration, *Ozonation, *Flexibility, *Los Angeles, *California, *Water treatment, Coagulation, Flocculation, *Design, Treatment facilities.

A 900 cfs water filtration plant is being designed to reduce turbidity in the Los Angeles Aqueduct water to 0.3 units and meet other water quality goals of disinfection and < 100 ppb trihalomethanes. This joint effort of the Los Angeles Department of Water and Power and the Metropolitan Water District of Southern California will feature ozonation in a flexible process train, which also includes coagulation in variable speed rapid mixers, flocculation, and filtration through single media. Pilot tests showed cationic polymer and ferric chloride to be most effective. Provisions for other chemicals (bentonite, alum, ammonia, caustic soda, and chlorine) increase the ability of the system to react quickly to changes in raw water quality. The plant will be built in 2 mirror-image modules. Sedimentation basins can be added later if necessary. Water can bypass sections of the treatment process if desired. An overflow structure will divert water to the Los Angeles reservoir when plant throughput exceeds demand. The plant is scheduled to begin operation in August 1985. (Cassar-FRC)
W83-02468

SORPTION INCINERATION OF CHLORINATED HYDROCARBONS, ACID, HEAVY METALS, AND EXCESS NUTRIENTS IN WATER USING COAL-DERIVED SOLIDS,
Missouri Univ.-Columbia. Dept. of Chemistry.
S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190652, Price codes: A02 in paper copy, A01 in microfiche. Missouri Water Resources Research Center Completion Report, Univ. of Missouri, Columbia, December 1982. 6 p, 1 Fig, OWRT B-150-MO(1), 14-34-0001-1279.

Descriptors: Water pollutants, *Activated char, *Organic pollutants, *Heavy metal, Water purification, *Incineration, *Sorption, Acids, Nutrients, *Coal, *Coal gasification, Coal pyrolysis.

Activated char produced by the gasification or pyrolysis of sub-bituminous coal was found to be effective in removing a number of important pollutants from water. Among these were organic byproducts produced from coal gasification and heavy metals. The organic byproducts of coal gasification served as model organic water pollutant compounds, and included hydrocarbons, phenols, and nitrogen compounds. Heavy metals were also effectively removed by the activated coal char. The char found most effective for heavy metal removal was that produced from 're-burning' char twice in a reverse-burn gasification mode. Subbituminous coal ash was likewise found effective in removing organic compounds and heavy metals from water.
W83-02484

OZONALYSIS FOR WATER REUSE APPLICATIONS,
Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
J. A. Roth, and K. A. Debelak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186510, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center Research Report No 82, Univ. of Tennessee, Knoxville, December 1982. 39 p, 12 Fig, 3 Tabs, 24 Ref. OWRT A-058-Tenn(3), 14-34-0001-0145.

Descriptors: *Ozone, *Water reuse, *Wastewater treatment, *Temperature, Decomposition, Solubility, Pollutants, Oxidation, *Hydrogen ion concentration.

Both the rate constants for ozone self-decomposition in aqueous solution and Henry's law constants were determined as a function of pH and temperature. A completely mixed, isothermal, semi-batch reactor system was used. The experimental conditions covered a pH range of 0.45 to 10.2 and a temperature range of 3.5C to 60C. The rate at which dissolved ozone undergoes self-decomposition is a function of pH and temperature of the aqueous solution. First order kinetics represent the self-decomposition of ozone satisfactorily. The relationship between the specific rate constant, hydroxide concentration, and temperature is determined over the range of variables investigated using multilinear regression. The ozone equilibrium concentration cannot be achieved when the rate of decomposition is significant relative to the rate of mass transfer of the ozone into the liquid. The solubility is calculated from experimental measurement of ozone uptake rate, ozone decomposition rate, and the steady ozone concentration. The ozone solubility in water varies with pH and temperature. The Henry's law constant was correlated with the temperature and hydrozide concentration using multilinear regression. These values are recommended for use rather than those of previous investigation who incorrectly assumed the experimentally determined steady state concentration was the equilibrium concentration.
W83-02498

A SMALL FACILITY FOR THE OZONE TREATMENT OF WATER (KLEINANLAGE ZUR OZONBEHANDLUNG VON WASSER),
Wasser, Luft and Betrieb, Vol 26, No 4, p 20, 1982. 1 Fig, 2 Tab. (No English Summary).

Descriptors: *Water treatment, *Ozonation, *Water treatment facilities, *Disinfection, *Drinking water, Ozonic 145, Mobile ozonation device, Wastewater treatment, Small water treatment facilities.

The treatment of small amounts of water with ozone has not usually been viable, due to high costs or technical problems. The Ozonic 145, a mobile or stationary device, allows ozone treatment of 2,000 l/hr of drinking water. A compressor connected to the ozone device draws in air from the atmosphere which is then dried by a 'heatless' mini-dryer to a dew point of -60C (prerequisite for optimal ozone production). The dried air is partially transformed into ozone as it passes through the ozone pipe, using the silent discharge principle. This occurs with the aid of patented electronic control procedure. An injector introduces the ozone into the water to be treated. Small

bubbles of ozone are most effective, as they provide optimal binding conditions due to their large surface area. A monitoring system ensures that no harmful ozone residue remains in the water. Small treatment facilities can produce 2, 4, 6, 8 or 12 g ozone/hr with a maximum concentration of 8 g/N cu m. The device is also suitable for larger facilities. As a mobile device, the Ozonic 145 is mounted on a flat-bed trailer and driven by a 3.7-kilowatt motor. A study was conducted to test the device using 500 l of water from an overloaded wastewater treatment facility to which T4 phages had been added. Ozone was mixed with the circulating water by means of an injector system in quantities of 1.4 g/hr at a concentration of 7 g/N cu m. Some degradable substances were completely degraded by the system, and disinfection was almost complete. Water quality was directly dependent upon redox potential; only when this reaches approximately + 600 millivolts is the water suitable for drinking. (Gish-FRC)
W83-02509

FORMATION AND REMOVAL OF MUTAGENIC ACTIVITY IN DRINKING WATER BY OZONISATION,
Antwerpse Waterwerken (Belgium).
F. Van Hoof.
Aqua, No 5, p 475-478, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Ozonation, *Chlorination, *Mutagens, *Water treatment, Drinking water, Organic matter, Meuse River, Fate of pollutants, Water pollution effects, *Belgium.

The effect of different ozone doses on mutagenic activity of chlorinated drinking water was studied using surface water derived from the River Meuse. The treatment process included breakpoint chlorination, alum and activated silica coagulation, dual layer filtration, and partial dechlorination with sodium bisulfite. Ozone doses were 1.9 + or - 0.2, 3.8 + or - 0.5, and 7.6 + or - 0.9 mg per liter. Neutral and acid (pH, 2) water samples were concentrated in ion exchange columns. All influents (neutral fraction) showed mutagenic activity on strains TA 98 (maximum levels of 40 revertants per liter) and TA 100 (maximum levels of 200 revertants per liter) without enzyme activation. No activity was detected on strain TA 98 in any ozonated samples (neutral fraction) with or without enzyme addition. Activity in strain TA 100 decreased after application of the lowest ozone dose. Increasing ozone doses further decreased activity on strain TA 100. Mutagenic activity was well correlated with levels of organic substances as expressed by ultraviolet absorbance. The acid fractions (hydrophilic compounds) of chlorinated and ozonated waters produced no mutagenic activity on TA 98, indicationg the absence of frameshift mutagens. However, ozonation markedly increased mutagenic activity of the acid fraction on strain TA 100. These mutagens were direct acting. Although ozonation removed direct acting mutagens from the neutral fraction, it increased formation of direct acting mutagens in the acid fraction. Therefore, ozone cannot be considered a good alternative to chlorine with respect to mutagenic activity in water. (Cassar-FRC)
W83-02510

THE DEGREE OF UTILIZATION OF ANION EXCHANGE FILTERS IN NITRATE REMOVAL FROM DRINKING WATER (AUSNUTZUNGSGRAD VON ANIONENAUSTAUSCHFILTERN BEI DER NITRATENTFERNUNG AUS TRINKWASSERN),
Ingenieurhochschule Zittau (German D.R.). Sektion Kraftwerksanlagenbau und Energieumwandlung.
J. Bosholm.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 83-87, 1980. 1 Fig, 6 Ref. (No English Summary).

Descriptors: *Anion exchange, *Filters, *Nitrates, *Nitrogen removal, *Drinking water, *Water treatment, Ions, Chlorides, Sulfates, Mathematical analysis, Graphical analysis.

The author's previously published method for the calculation of ion exchange processes is used to estimate the influence of various concentrations of chloride and sulfate ions on the efficiency of highly basic anion exchangers in the chloride form used to remove nitrates in the treatment of drinking water. The degree of utilization of such a filter is illustrated in a diagram for contents of 0.500 mg/l chloride and sulfate ions and for a nitrate ion concentration of 60 mg/l. The diagram permits easy calculation of the degree of utilization and run time for ion exchange filters for various compositions of water. From the degree-of-utilization value given by the diagram, the usable volume capacity (assuming a breakthrough concentration of the nitrate ions of 0.3-0.5) can be calculated; from this, the volume of water that can be treated up to this breakthrough point can be found. Similar predictions for other breakthrough concentrations can be made if the breakthrough curve is calculated; this is possible if concrete operating data for the ion exchange filter are known. Agreement between values calculated by means of the diagram and previously published experimental values was good. (Gish-FRC)
W83-02512

EFFECT OF RECOVERY ON DESALINATION OF THE BLACK SEA WATER BY REVERSE OSMOSIS,
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
For primary bibliographic entry see Field 3A.
W83-02522

SHIP-MOUNTED SEAWATER 2500 CU M/D FLASH EVAPORATION PLANT FOR ADU DHABI. ECONOMICAL DRINKING WATER FOR ARID REGIONS,
Buckau-Walther A.G., Essen (Germany, F.R.). Water Engineering Div.
For primary bibliographic entry see Field 3A.
W83-02524

HIGH PURITY WATER USING H202 AND UV RADIATION,
Interox Chemicals Ltd., Widnes (England).
N. Clarke, and G. Knowles.
Effluent and Water Treatment Journal, Vol 22, No 9, p 335-338, 340-341, September, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Water treatment, Water quality, *Feedwater treatment, Boilers, *Hydrogen peroxide, Oxidation, Chlorination, Chlorides, Demineralization, Industrial water, Radiation, *Ultraviolet radiation.

Organic contamination in raw water supplies can cause severe problems in a variety of industrial processes, particularly in the treatment of water for boiler feed in steamraising equipment. The article discusses the development of a method for the oxidation of dissolved organics in water using photoactivated hydrogen peroxide. UV/H202 treatment as an additional stage in the preparation of demineralized water for boiler feedwater makeup is shown to improve water quality by converting organic matter to carbon dioxide or to lower molecular weight organic compounds, possibly with active groups with less tendency to foul the anion resins, and degrading the organic chlorides present in the water to ionic chloride, which could then be removed on the anion resins and, as a consequence, not pass forward to the boiler feed water. As a result of this treatment it should be possible to keep the anion resin beds in good condition for longer periods. The lower levels of organic chloride going to the boilers will maintain the chlorides in boiler water within required limits with very much reduced blowdown levels. The net result will be substantial savings in water and heat losses. (Baker-FRC)
W83-02531

WATER CHEMICALS CODEX,
National Research Council, Washington, DC.
R. Rehwoldt.
Environmental Science and Technology, Vol 16, No 11, p 616a-618A, November, 1982. 2 Tab.

Descriptors: *Chemicals, *Water treatment codex, *Standards, National Academy of Sciences, National Research Council, Water treatment, Coagulation, Flocculation, Chemical precipitation, Disinfection, Water softening, Chemical analysis.

The National Research Council's Committee on Water Treatment Chemicals developed a Water Treatment Chemicals Codex. It consists of a series of monographs, each on a specific water treatment chemical. Monographs include chemical and physical properties, function, use range, purity requirements, bulk sampling procedures, and analytical procedures. The formulas for calculating the Recommended Maximum Impurity Content for the additives is given. The following compounds are included in the Codex: aluminum sulfate, ammonia, ammonium hydroxide, ammonium sulfate, calcium hydroxide, calcium hypochlorite, calcium oxide, activated carbon, carbon dioxide, chlorine, ferric chloride, ferric sulfate, ferrous sulfate, fluosilicic acid, potassium permanganate, sulfur dioxide, and sodium salts (aluminate, carbonate, chlorite, fluoride, hydroxide, hypochlorite, metabisulfite, silicofluoride, and polyphosphate). (Cassar-FRC)
W83-02546

PESTICIDES IN GROUNDWATER: THE ALDICARB STORY IN SUFFOLK COUNTY, NY,
Suffolk County Dept. of Public Health, Hauppauge, NY.
M. H. Zaki, D. Moran, and D. Harris.
American Journal of Public Health, Vol 72, No 12, p 1391-1395, December, 1982. 4 Tab, 6 Ref.

Descriptors: *Groundwater pollution, *Drinking water, *Agricultural runoff, *Carbamate pesticides, *Water pollution sources, *Groundwater movement, Potable water, *Aldicarb, Pesticides, Insecticides, Public health, Wells, Water pollution effects, Monitoring, *New York, Suffolk County.

In August of 1979, traces of the carbamate pesticide aldicarb were detected in groundwater samples of Suffolk County, New York. Although the pesticide reached human drinking water supplies, no cases of carbamate poisoning were reported in area hospitals. An extensive monitoring program conducted by the County in cooperation with federal and state agencies and the Union Carbide Corporation showed that 13.5% of the 8,404 wells sampled exceedewd the state recommended limits for aldicarb of 7 parts per billion. Residents whose wells exceeded this limit were advised not to use the water for drinking or cooking and to obtain an alternate source of potable water. The Union Carbide Corporation provided these residents with activated carbon filtration units to remove most of the aldicarb and its metabolites. The aldicarb incident in Suffolk County raised many serious issues concerning the testing of pesticides under field conditions prior to registration and during their use, the validity of recommended action levels, and the long-term health effects resulting from the consumption of pesticides in trace concentrations. (Geiger-FRC)
W83-02560

DECOMPOSITION OF OZONE IN WATER: RATE OF INITIATION BY HYDROXIDE IONS AND HYDROGEN PEROXIDE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Staehelin, and J. Holgne.
Environmental Science and Technology, Vol 16, No 10, p 676-681, October, 1982. 8 Fig, 1 Tab, 31 Ref.

Descriptors: *Ozone, *Decomposition, *Drinking water, Potable waters, Wastewaters, Hydroxide ions, Oxidation, Ozonation, *Water treatment, Chemical reactions.

Studies were undertaken to separate, identify, and quantify the successive individual reactions that control the overall rate of ozone decomposition in drinking water and other aqueous solution. The results will allow better predictions of how the rates will be influenced by changes in water composition. The kinetics by which the decompostion of ozone in water is initiated by water itself is described under conditions where secondary radi-

cal-type chain reactions are excluded by OH-radical scavengers. Such situations resemble those encountered when natural waters are ozonated. The findings suggest that reactions of OH- and HO2- with ozone can initiate radical chain reactions. The kinetic chain length of such reactions depends on the relative rate by which the radicals formed react with ozone compared with other solutes present in the solution. Therefore such chain reactions can be more important in pure water than in real drinking water or in some types of wastewaters where bicarbonate and organic impurities may significantly scavenge OH-radicals. (Baker-FRC)
W83-02577

ANODIC OXIDATION FOR DRINKING WATER DISINFECTION, PART 1: BACTERIOLOGIC STUDIES IN PRACTICAL USE (ANODISCHE OXYDATION TRINKWASSERDESINFEKTION, 1. MITTEILUG: BAKTERIOLOGISCHE UNTERSUCHUNGEN BEI PRAXISEINSATZ),
Mainz Univ. (Germany, F.R.). Hygiene Inst.
M. Borneff.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 4, p 141-146, April, 1981. 2 Fig, 5 Tab, 10 Ref.

Descriptors: *Bacteria, *Anodic oxidation, *Water purification, *Drinking water, Water quality, *Water treatment, Oxidation, Chlorination, Haloforms, Microbiological studies, *Federal Republic of Germany.

The bactericidal effect of anodic oxidation for water purification was tested in an electrolytic polarization unit developed by Reis et al. The results attained in laboratory experiments (reduction of E. coli approximately log 7) agreed with those of other authors under practical conditions; however, the inactivation was less effective (reduction of waterborne bacteria about 1-3 log). In comparison to other means of water disinfection the anodic oxidation system still needs to be improved technically and econimically before being put into practical action. Its decontaminating effect is caused mainly by production of free chlorine, thus implying the formation of haloforms. (Author's abstract)
W83-02588

ANODIC OXIDATION FOR DRINKING WATER DISINFECTION, PART II: STUDIES ON HALOFORM FORMATION (ANODISCHE OXIDATION ZUR TRINKWASSERDESINFEKTION, II. MITTEILUNG: UNTERSUCHUNGEN ZUR HALOFORMBILDUNG),
Mainz Univ. (Germany, F.R.). Hygiene Inst.
E. H. Pfeiffer.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 5, p 185-189, May, 1981. 7 Fig, 3 Tab, 6 Ref.

Descriptors: *Drinking water, *Disinfection, *Haloforms, *Oxidation, Anodic oxidation, *Water treatment, Trihalomethanes, Chloroform, Bromoform, Chlorine, Chlorination, Hypochlorite, Chemical reactions, *Federal Republic of Germany.

The formation of haloforms was analyzed during oxidation treatment of different water samples under field and laboratory conditions. Employing a current of 3 to 9 A in field experiments the total of the trihalomethanes (chloroform, dichlorobromomethane, dibromochloromethane, and bromoform) in the water increased from 0.15 to 26.1 micrograms/liter, surpassing the level of 25 micrograms/liter recommended by the drinking water commission of the BGA. Up to 5 A haloform concentrations were similar to those resulting from treatment by chlorination; however, with 5 A bacterial inactivation was not sufficient. Laboratory experiments with a smaller reactor cell made it possible to analyze the impact of water quality on haloform formation. An additional increase in haloform concentration was noted when 5 mg/1 humic acid was added to the water. In tap water with high initial haloform concentrations of 34.7 micrograms/liter, treatment with high current intensities increased this concentration to 101.7 micrograms/liter. The free chlorine increased exponentially with increasing current intensity, reaching values above 7 micrograms/liter. These findings suggest that the effect of A0 on waters containing electrolytes is based mainly on the formation of hypochlorite. (Baker-FRC)
W83-02589

THE DEVELOPMENT OF THE PUBLIC DRINKING WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY IN THE FIRST QUARTER OF 1982 (DIE ENTWICKLUNG DER OFFENTLICHEN TRINKWASSERVERSORGUNG IN DER EUNDESREPUBLIK DEUTSCHLAND IM I. QUARTAL 1982),
Bundesgesellschaft fuer Wirtschaft (Germany, F.R.).
D. Perdelwitz.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 7, p 365-368, July, 1982. 8 Tab. (No English Summary).

Descriptors: *Water supply, *Drinking water, *Water delivery, *Water demand, *Statistics, Surveys, *Federal Republic of Germany, Precipitation, Air temperature, Weather.

Statistics collected by the BGW (German Economics Group) in a random sampling of III West German water supplying concerns (WSC) for the first quarter of 1982 are discussed. The sample is considered representative of the entire West German public water supply system. Air temperature for the period (measured at six weather stations and averaged) was 1.6C, 1.0C higher than the first quarter of 1981 and 0.1C less than the long-range mean. Precipitation was 485 mm, 34% less than in 1981 (735 mm). Compared with the first quarter of 1981, water output rose by 0.2%, water supply rose by 0.2%, and water delivery to users rose by 0.8% (in contrast to the two preceding years, when it dropped slightly), while delivery to water suppliers dropped by 0.3% (due entirely to WSC with volumes of > or = 20 million cu m/yr delivering 0.4% less; the two smaller groups of WSC delivered 1.3 17.1% more water than in 1981). The sum of water use by the WSC themselves, losses, and reservoir surplus was 0.7% less in 1982 than in 1981 (in 1,000 cu m, 32,481 versus 34,929). Peak demand was almost the same in 1982 as it had been in 1981, the largest delivery in 1,000s of cu m in 1982 being 7,980, versus 8,152 in 1981 (average delivery, 6,929 in 1982, 6,885 in 1981). However, peak demand declined for the two smaller groups of WSC, while it remained constant for the largest group. In comparison with the first quarter of 1981, producer prices for water increased by 9.2%: by 9.5% for private households and by 8.8% for industrial users. Absolute prices increased more: by 10.3% for a household using 10 cu m/month, by 9.4% for industrial users of 1,000 cu m/month, and by 10.5% for industrial users of 10,000 cu m/month. (Gish-FRC)
W83-02607

CONVENTIONAL, UPFLOW, AND RADIAL FILTERS: COMPARISON AND MATHEMATICAL MODELLING,
S. Vigneswaran, and Y. A. P. Perera.
Effluent and Water Treatment Journal, Vol 22, No 10, p 377-381, October, 1982. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Filters, *Performance evaluation, *Head loss, *Water treatment, Upflow filters, Radial filters, *Rapid filters, Model studies.

Performances of upflow, radial, and conventional (single medium downflow) filters are compared. Head loss development is lower and more distributed over the filter depth in upflow filters than in conventional filters. Head loss profiles for comparable filter bed thicknesses show that head loss development in a radial filter is lower than that of a conventional filter and higher than that of an upflow filter. Bed volumes for upflow and radial filters are 1.2 times and 2 times greater, respectively, than those of conventional filters. Longest filter runs are produced by upflow filters, followed by radial filters. Mathematical modeling allows prediction of radial filter effluent concentrations using parameters calculated for the conventional filter. (Cassar-FRC)
W83-02615

EVALUATION OF THE RESULTS OF DRINKING WATER STUDIES ACCORDING TO APPENDIX 1 TO PARAGRAPH 3 OF THE DRINKING WATER ORDINANCE (AUSWERTUNG DER ERGEBNISSE VON TRINKWASSERUNTERSUCHUNGEN GEMASS ANLAGE 1 ZU PARAGRAPH 3 DER TRINKWASSERVERORDNUNG),
Baden-Wuerttemberg Landesanstalt fuer Umweltschutz (Germany, F.R.). Inst. of Seenforschungs Fischereiwesen.
R. Feierabend, H. Hagenmaier, and G. Wagner.
Gas- und Wasserfach: Wasser/Abwasser, Vol 122, No 10, p 446-451, October, 1981. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Drinking water, *Pollutant identification, Water quality, Water supplies, Sulfates, Nitrates, Fertilizers, *Federal Republic of Germany, *Water quality standards.

The Order Concerning Drinking Water in Germany came into force in 1976. Twelve constituents injurious to health were to be determined in drinking water samples. According to results based on 700 samples, dividing the quality of the water sampled into six categories according to degree of contamination, most concentrations fell below 10% of the limiting value as well as below the sum of the limit of detection plus allowable error of measurement. Moderate values were frequently found in the cases of nitrate from fertilizers and sulfate from geological formations. (Baker-FRC)
W83-02618

COMPARISON OF THE DRY SUBSTANCE OF SESTON AND THE POTASSIUM PERMANGANATE CONSUMPTION IN THE RAW WATER FOR THE DRINKING WATER SUPPLY OF THE TOWN OF ROSTOCK (VERGLEICH DER SESTONTROCKENMASSE UND DES KALIUM PERMANGANATVERBRAUCHS IN ROHWASSER DER TRINKWASSERVERSORGUNG ROSTOCKS),
Rostock Univ. (German D.R.). Bereich Medizin.
L. Kalbe, K. Fender, and E. Grabitz.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 97-100, 1980. 3 Fig, 5 Ref. (No English Summary).

Descriptors: *Drinking water, Raw water, *Filtrate, *Potassium compounds, Comparison studies, Rostock, *German Democratic Republic, *Potasium permanganate, Projections, Correlation analysis, Mathematical studies, *Seston dry matter, Seston, Water treatment.

A comparison of filterable matter (seston dry mass, DM) and potassium permanganate (PP) consumption in raw water used for drinking water supplies in the city of Rostock (German Democratic Republic) was conducted for the years 1970-1977. The raw water was taken from the Warnow river. Mean monthly values for the eight-year period were 8.0 mg/1 for DM and 40.7 mg/1 for PP, with a correlation coefficient of 0.444. The correlation coefficient was significant at 5%, but was considered weak. For certain times of year (e.g., January-February, April-May-June, August-September, and October-November-December), mean monthly values of DM and PP showed a similar trend, but they diverged for February-March-April (DM declined while PP increased), June-July-August (DM decreased sharply then rose moderately, PP decreased gradually), and September-October (DM rose slightly, PP continued to decline). These differences were assumed to be due to changes in bioproduction, especially in spring (May), when biogenic suspended solids comprised the bulk of oxidizable oranic matter. Mean annual values displayed a basically similar trend for the study period. Data for PP was available for a longer period, and mean annual values were somewhat periodic: values increased continually during 1965-1970 and 1971-1975, and these increases were followed by brief decreases. This suggests that for long-term projections, values measured over periods of at least 10 yr should be used. From 1974 onwards, PP values were higher than ever before (> 41 mg/1); this could not be attributed to increased precipitation, since there was generally a drought from 1971 to 1976. (Gish-FRC)
W83-02641

HEMOGLOBIN-GLUTATHIONE RELATIONSHIPS IN TROUT ERYTHROCYTES TREATED WITH MONOCHLORAMINE,
Seattle Metro Water Quality Lab., WA.
For primary bibliographic entry see Field 5C.
W83-02660

TECHNICAL NOTE: REMOVING TRIHALOMETHANE FORMATION POTENTIAL BY COAGULATION WITH ACTIVATED SILICA AND CATIONIC POLYMER,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
B. Batchelor, and P. Yang.
Journal of the American Water Works Association, Vol 74, No 9, p 494-496, September, 1982. 4 Fig, 9 Ref.

Descriptors: *Water treatment, *Trihalomethanes, *Coagulation, Polymers, Activated silica, Silica, Drinking water, Potable water, Chemical reactions.

The results of jar test experiments are presented which demonstrate the limited ability of activated silica and a cationic polymer to remove trihalomethane formation potential (THMFP) when used as the sole coagulant or in conjunction with alum. A possible mechanism is derived to explain the results. All water samples were collected from the surface of Lake Somerville, near the water intake for Brenham, Texas. While the conclusions are limited by the experimental conditions studied and the water supply sampled, they suggest that the medium-molecular-weight cationic polymer used in the studies was not effective in removing THMFP when used alone or in conjunction with alum. A dose of activated silica (0.5 mg/L) substantially improved removal of THMFP when used alone or in conjunction with alum. When alum was the sole coagulant or when it was used in conjunction with activated silica or a cationic polymer, the pattern of THMFP removal could be explained in terms of the formation of positively charged colloids consisting of natural organic matter and aluminum hydroxides. The efficiency of activated silica in removing trihalomethane formation potential indicates that anionic organic polymers should also be evaluated for this purpose. (Baker-FRC)
W83-02681

MAINTAINING AGING SYSTEMS - BOSTON'S APPROACH,
Massachusetts Water and Sewer Commission, Boston.
J. P. Sullivan, Jr.
Journal of the American Water Works Association, Vol 74, No 11, p 555-559, November, 1982. 7 Tab, 8 Ref.

Descriptors: *Water distribution, *Maintenance, *Municipal water, Corrosion, Metering, Decision making, Planning, Lining, Water loss, Boston, Massachusetts.

A general description is offered of Boston's water supply. Current problems are reviewed with the capital plan and a discussion is given of programs designed for the rehabilitation and continuous maintenance of the water distribution system. By concentrating on three major areas: metering, leak detection, and a relaying and relining program, Boston is expected to reach its goal of having all mains more than 100 years old cleaned and relined or replaced by the year 2000. Currently the largest losses of water are attributed to meters that underregister water consumption. If, after remetering is performed, customers react as predicted to substantial increases in bills by repairing internal leaks, the overall effect will be a slight increase in metered sales against a more drastic drop in purchased water. Currently the city is in the sixth year of its 10 year leak detection program. The effects have been multiplying annually as more knowledge is gained about the system. By the end of 1981 about 70% of the system was surveyed with the remaining 30% left to go. While the city has a low frequency of main pipe failures, much of the pipe is heavily tuberculated or undersized for its present use. To achieve the goal of relining or replacing pipe more than 100 years old, about 18 km or pipe or 1% of the system must be rehabilitated or replaced annually. Priority scheduling for replacing or rehabilitating pipe is based on maintenance records, age records, loss of head tests and fire flow tests as well as proposed roadway construction by city and state agencies. (Baker-FRC)
W83-02689

SURVEY OF POLYELECTROLYTE COAGULANT USE IN THE UNITED STATES,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman.
Journal of the American Water Works Association, Vol 74, No 11, p 600-608, November, 1982. 2 Fig, 26 Tab, 1 Ref.

Descriptors: *Coagulants, *Polyelectrolytes, *Standards, *Water treatment, Turbidity, Water quality, Surveys, Drinking water, Flocculation, Chemical analysis.

An analysis is presented of answers offered by more than 300 utilities to questions concerning their use of polyelectrolyte coagulants. The 'typical' plant uses polyelectrolyte coagulants in the treatment of water from a surface source and uses a conventional solid-liquid separation system. The raw water turbidity is higher than average in such cases. The plant adds a cationic polyelectrolyte solution in combination with alum to the raw water at the plant intake or the rapid mix unit. The dosage is on the order of 0.4 mg/liter. The plant uses about 46,000 pounds of polyelectrolyte per year for which it spends roughly $23,000. Although the polyelectrolyte may be purchased by private negotiations, it is equally likely that public bidding is used. Prospective suppliers are prequalified by a combination of laboratory jar tests and full-scale plant evaluations. The plant personnel feel that a polyelectrolyte standard is needed, and their greatest concerns are being able to measure the amount of active ingredient and the presence of unwanted contaminants in the solutions purchased. (Baker-FRC)
W83-02691

DESIGNING AND INSTALLING LARGE STEEL WATER MAINS TO PREVENT FAILURES,
Saint Louis City Water Div., MO.
S. T. Fletcher.
Journal of the American Water Works Association, Vol 74, No 11, p 568-575, November, 1982. 6 Ref.

Descriptors: *Pipelines, *Design criteria, *Installation, Maintenance, Inspections, Water conveyance, Water mains, Missouri, St. Louis.

Certain proven precautions can be taken in the design and installation of large-diameter steel conduits to prevent failures. Problems are illustrated by a description of a massive failure of an 1800 mm pipeline, the resulting investigation to determine the cause of the failure, and the legal settelement of damages. Factors seen to affect and promote brittle failure include the state of stress, temperature, impact load, weld defects, excessive cold work, stress concentrations, and thickness of plate. Controls to resist brittle fracture include composition, deoxidation practices and grain size. The pipe failure described occurred at the St. Louis Water Division on December 24, 1973. From the investigation of this failure it was determined that designers need to review each large diameter pipeline on an individual basis. Then a pipeline combines high hoop stresses, extreme temperatures, welded bell and spigot joints, and high value areas, a more closely controlled steel specification may be justified for portions of the pipeline. (Baker-FRC)
W83-02710

ORGANIZING AND ANALYZING LEAK AND BREAK DATA FOR MAKING MAIN REPLACEMENT DECISIONS,
D. K. O'Day.
Journal of the American Water Works Association, Vol 74, No 11, p 589-594, November, 1982. 6 Fig, 6 Tab, 12 Ref.

Descriptors: *Water mains, *Maintenance, Leakage, Water loss, Pipes, Water distribution, Decision making, Pipelines, Water conveyance.

Water main replacement decisions may be based on arbitrary criteria such as age or on historic operating records and the experiences of a utility. Use of the latter method enables a utility to analyze leak and break patterns and to develop rehabilitation-replacement plans. An overview is provided of the causes of water main breaks and leaks. Several studies are described in which main breaks have been analyzed in terms of pipe age, geographic location, and diameter. The cost of replacing a mile of water main is $200,000 to $500,000 in 1980 dollars. During this period of rising costs, shrinking revenues, and high interest rates, main rehabilitation-replacement decisions should be based on sound, reliable information. Replacement decisions should be based on the physical condition of mains, not on their age. A geographically oriented information system will cost $50 - $150 per mile to develop and $10 - $20 per year per mile to update with routine records. The monetary gain from improved main replacement decisions is several orders of magnitude greater than the cost of the information system. (Baker-FRC)
W83-02712

INSPECTING, PAINTING, AND MAINTAINING STEEL WATER TANKS,
Harper and Associates, Inc., Riverside, CA.
For primary bibliographic entry see Field 8G.
W83-02713

MAINTAINING DISTRIBUTION SYSTEM VALVES AND FIRE HYDRANTS,
Saint Louis County Water Co., University City, MO.
For primary bibliographic entry see Field 8C.
W83-02714

VOLATILE ORGANIC COMPOUNDS IN WATER AT THIRTY CANADIAN POTABLE WATER TREATMENT FACILITIES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5A.
W83-02715

AERATION-DESTRATIFICATION OF LAKE EUREKA USING A LOW ENERGY DESTRATIFIER,
Illinois State Water Survey Div., Champaign.
V. Kothandaraman, and R. L. Evans.
ISWS Circular 155, 1982. 32 p, 17 Fig, 7 Tab, 18 Ref, 4 Append.

Descriptors: *Water quality, *Water treatment, *Destratification, *Lake restoration, *Aeration, Algae, Algal control, Oxygen demand, Chemical treatment, Raw water, Manganese, Chlorine, Iron compounds, Cost-benefit ratio, Costs, Odor control, *Illinois, Lake Eureka.

Lake Eureka had been a water supply source for about 40 years but, because of severe odor and taste problems, the city switched to a groundwater source; however, operational problems and higher costs ensued. The main purpose of the aeration-destratification was to determine if the lake's water quality could be improved by in-lake treatment so that it could be used again as a raw water supply source. From May through October 1981, a low-energy, mechanical, reversible draft destratifier was installed and used in combination with periodic applications of chelated copper sulfate followed by potassium permanganate. Physical, chemical and biological characteristics were monitored at the lake's deepest station. Using a 1 1/2 hp motor, the aerator was able to completely destratify the lake and maintain adequate oxygen levels throughout, even in deep bottom waters. Iron and manganese concentrations in the deep waters were reduced 97% from pre-aeration levels and chlorine demand values were reduced more than half. A prior study had correlated odor episodes in finished water with manganese and chlorine demand values. Treatment also caused a dramatic shift in

algal species, replacing problem causing blue-green algae with diatoms as the dominant species during summer months. Water quality was enhanced enough so that the lake can again be used as a raw water source. Operating the aerator-destratifier and chemical treatments will cost about $1,500. The cost savings in using lake water vs. groundwater will amount to $24,000 in power costs and $10,000 in chemical costs per year, and will benefit both the general public and direct water users. (Atkins-Omniplan)
W83-02720

CONTROL OF HALOFORM PRODUCTION DURING CHLORINATION OF NATURALLY OCCURING COMPOUNDS THROUGH PRE-OZONATION,
Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
L. M. Hays, B. M. Baum, R. A. Isaac, and J. C. Morris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191825, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 131, University of Massachusetts, Amherst, October 1982. 44 p, 16 Fig, 39 Ref, 1 Append. OWRT A-118-Mass(1), 14-34-0001-9023.

Descriptors: *Ozonation, *Chlorination, *Chlorinated Hydrocarbons, *Organic compounds, Carcinogens, Drinking Water, Potable Water, Alkaline water, *Trihalomethane, *Water treatment.

Trihalomethane (THM) can be produced upon chlorination of water containing naturally occuring organic compounds. Compounds investigated here were resorcinol, phloroglucinol, vanillin, syringaldehyde, tryptophan, indole, and alanine. The 8:1 molar ratio of HOCl to non-ozonated samples of organic compounds is less than the theoretical chlorine demand for all compounds but alanine. However, each experiment was monitored until only a very graduate increase in demand was being observed. Preozonation was effective at pH 7 in reducing haloform production in chlorinated samples of all of the compounds except alanine which exhibited an increased yield. Four of the seven compounds were also tested at pH 10. The results with alanine and syringaldehyde were consistent with those at pH 7 since more chloroform was produced with preozonation of the former while less resulted with preozonation of the latter. The remaining two compounds (vanillin and tryptophan) exhibited greater chloroform production after preozonation at pH 10 while the opposite occured at pH 7. There is no obvious explanation for this conflict, which should be verified in the case of vanillin, but it might be due to different oxidation mechanisms at pH 7 and pH 10. This possible effect also could impact the results with tryptophan.
W83-02727

ATTACKING ODORS WITH H202,
Camp, Dresser and McKee, Inc., Albuquerque, NM.
J. A. Burgh, and A. N. Gaume.
Water/Engineering and Management, Vol 129, No 11, p 26-28, 1982. 2 Fig, 2 Tab.

Descriptors: *Water quality, *Hydrogen peroxide, *Oxidation, Odors, Taste, Water supply, Drinking water, Potable water, Water treatment.

The application of hydrogen peroxide to control wastewater collection system odors is gaining in popularity. This powerful oxidizing agent is in itself relatively expensive, but the equipment needed for its storage and feeding is often not expensive. Use of H202 is particularly helpful for seasonal problems, in cases where installations must be made rapidly, where low capital cost is a primary consideration, where points of application are remote from treatment plants or other occupied facilities, and where effective control of odors is absolutely required. The performance of a typical system using H202 treatment is described. (Baker-FRC)
W83-02765

AQUATIC INVADERS,
Williamsport Sanitary Authority, PA. Wastewater Div.
M. H. Gerardi, and J. K. Grimm.
Water/Engineering and Management, Vol 129, No 11, 22-23, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: Water quality, *Aquatic animals, *Water distribution, Drinking water, Potable water, Shrimps, Fleas, Midges, Worms, Water quality control, Filtration, Filters, Pesticides, Pyrethroids, Water treatment.

Odor, taste and color problems in water supply systems are frequently the result of aquatic species found in water which had been treated and is ready for consumption. The most common animals thus found include the segmented worms, water fleas, freshwater shrimps, and midges. The appearance of aquatic animals within a water treatment plant or distribution system will coincide with the natural population cycles or breeding peaks for each species. Aquatic species may enter a distribution system through open reservoirs or through treatment plants which lack filtration units or which operate filtration units improperly. Since an infestation of aquatic animals is most likely to occur in spring or summer, water mains can be spot checked or surveyed for their presence during these seasons. If mains are infested, systematic flushing or pesticide dosing can be used to remove the animals. Pyrethrin, bioresmethrin, permethrin and resmethrin have been successfully used for this process. (Baker-FRC)
W83-02766

HALTING CREEK POLLUTION,
Rogue Valley Council of Governments, Central Point, OR.
For primary bibliographic entry see Field 5B.
W83-02768

KEEPING CLEAN WATER CLEAN,
East Bay Municipal Utility District, Oakland, CA.
K. B. Stinson.
Water/Engineering and Management, Vol 129, No 11, p 30, 32-33, October, 1982. 3 Fig, 4 Ref.

Descriptors: *Storage tanks, *Reservoirs, *Design criteria, *Water quality, Water quality control, Disinfection, Chlorine, Surface drainage, Construction, Materials, Corrosion, Water distribution, Water supply.

The quality of water can deteriorate for a variety of reasons on its way through a distribution system. Established practices that should be remembered and applied during the design, construction and operational stages of a typical water supply system are reviewed. Tanks and reservoirs should be made inaccessible to the public. They should be covered and protected from surface drainage. The water's exposure to sunlight should be minimized to prevent nuisance algal growths. All openings, including air vents, to the reservoir should be provided with insect-tight screens. Each access to the interior of the tank or reservoir should be equipped for inspection, cleaning and disinfection. The bottom of the tanks or reservoir should slope to a drain to facilitate washdown. Fire hydrants should be installed around the tank or reservoir to provide high-pressure water for hosing down the interior. Materials for use in tanks and reservoirs should be corrosion resistant. Spider rods should be eliminated from the inside of the tanks where feasible. A tap on the tank or reservoir inlet-outlet line to facilitate the injection of chlorine solutions for disinfection is useful. (Baker-FRC)
W83-02780

VALVE AND HYDRANT MAINTENANCE,
Waukesha City Water Utility, WI.
J. H. Kuranz, and B. S. Barrett.
Water/Engineering and Management, Vol 129, No 11, p 33-34, 37-38, November, 1982. 3 Fig, 1 Ref.

Descriptors: *Maintenance, *Valves, *Hydrants, Water distribution, Water supply, Cost-benefit analysis, Water quality control.

All water utilities should have an established, progressive valve and hydrant maintenance program. It should involve periodic valve exercising, hydrant inspections, painting, and other routine servicing and recording operations. A review of valve and hydrant maintenance programs indicates several practices and procedures which are among those most commonly used by water utilities. The most vital aspect of the maintenance program is the checking of opening and closing functions, drainage, and the condition of the threads on the nozzles. (Baker-FRC)
W83-02782

SLOW SAND FILTRATION FOR CERCARIAL CONTROL IN NORTH CAMEROON VILLAGE WATER SUPPLY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Health Engineering.
K. Kawata.
Water Science and Technology, Vol 14, No 6/7, p 491-498, 1982. 3 Tab, 10 Ref.

Descriptors: *Sand filters, *Drinking water, Reservoirs, *Public health, Filtration, Water supply, Water resources development, Dams, *North Cameroon, *Cercarial control, Schistosomes, Literature reviews, Water treatment.

A literature survey was conducted on past filtration studies in order to determine methods to aid in the control of cercariae of human schistosomes. Such health problems are matters of concern in the area of North Cameroon, as attempts are being made to provide water closer to villages through the construction of series of internationally and bilaterally financed dams built to impound water in reservoirs. From the literature survey it was determined that infiltration studies of the past often gave little information on sand characteristics and operating parameters. There were no indications in the papers reviewed that filter rates were ever controlled. A better designed and controlled filtration study was therefore conducted. The results of these tests dictated the selection of sand grains of uniformity coefficient less than 2.0 and effective size of 0.3 mm or less. The filter was designed at 1.2 m initially. During its period of use it may be scraped down in depth, but never to a depth less than 0.6 m. The infiltration rate must be controlled. The design rate was selected to be 0.12 m/hr. All filters are to be thoroughly conditioned before being placed on line, and at no time should the sand bed be allowed to be without water. Field capability for microbiological quality testing was incorporated into the project. Where needed, a simple chlorination process will be added in the treatment train to provide multiple barriers to assure water quality. (Baker-FRC)
W83-02790

COMPUTER-BASED TELEMETRY MONITORS WATER USE,
Public Works, Vol 113, No 12, p 40-41, December, 1982.

Descriptors: *Computers, *Control systems, *Water consumption, Automation, Reservoirs, Monitoring, South Coast County Water District, California, Remote sensing, Water demand, Water level, Water supply, Water flow, Water distribution, Water use.

A computer system monitors, controls, and records water flow for the South Coast County Water District, south of Los Angeles, California. The local district has no direct control over supplies, which come from the Metropolitan Water District (MWD). If changes in demand are expected, a 24-hour notice must be given to the MWD. Daily consumption varies widely and unpredictably from 2 to 6 million gallons. The system uses two 16K minicomputers, 2 CRTs, 3 printers, and telemetering equipment. Measurement of the storage reservoir level is used to automatically operate pumps. Alarm systems include signals for high level, low level, and danger. Data, including water levels and pump discharge pressures, are used to accurately predict future water demands on a daily basis. A variety of hard-copy reports is generated. (Cassar-FRC)
W83-02794

COMPUTER ASSISTED ANALYSIS TO IMPROVE WATER SYSTEM OPERATION,
CH2M/Hill, Seattle, WA. Water and Waste Div.
D. C. Martin.
Water/Engineering and Management, Vol 129, No 11, p 8-9, 1982. 1 Fig.

Descriptors: *Water distribution, *Model studies, *Computers, Water conveyance, Pipelines, Water supply, Pumps, Cost analysis, Wells, Management, Decision making.

A typical computer assisted analysis is based on a mathematical model of the water system. The model simulates pipelines, pump stations, reservoirs and regulating valves. Operational conditions such as demand, supply rate and head, and reservoir water level are imposed on the model. The computer program processes the data and calculates system pressure, water velocity and head loss in the pipelines. When a water utility must change from a multiple well supply system to a single source supply, the operating conditions are significantly changed even without increased demand. The effects of a new single supply connection on the distribution system include high head losses in the pipelines near the supply, resulting in low service pressures. The most costly potential effect is that distribution and storage facilities will no longer be properly situated to be compatible with the new supply. Applications of computer analysis are also considered briefly for situations of power management, supply flow constraints and pump efficiency. (Baker-FRC)
W83-02799

5G. Water Quality Control

RESPONSIBILITY FOR RUNOFF CONTROL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W83-02467

THE ROTSEE - AN EXAMPLE OF A LAKE IN WHICH WATER POLLUTION CONTROL MEASURES WERE SUCCESSFUL (DER ROTSEE - EIN BEISPIEL FUR EINEN SEE, BEI DEM DIE GEWASSERSCHUTZMASSNAHMEN ERFOLGE BRACHTEN),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
P. Stadelmann.
Wasser, Energie, Luft, Vol 74, No 1/2, p 12-13, January/February, 1982. 1 Fig, 2 Tab, 1 Ref. (No English Summary).

Descriptors: *Eutrophic lakes, *Phosphorus, *Water pollution control, *Wastewater treatment, *Lake restoration, *Switzerland, Rotsee, Lucerne, Oxygen, Destratification, Rehabilitation.

The causes of eutrophication of the Rotsee (Lucerne, Switzerland) are described, together with measures undertaken to improve its condition, some of which were eventually successful. Discharge of wastewaters from the city of Lucerne into the lake began in 1850, and pollution by nutrients resulted in visible algal blooms by 1910, while the first chemical analysis in 1916 showed only 1 mg oxygen/l at depths of 0-10 m. The lake was eutrophic by 1920. In 1921-22, a canal was built to introduce 400 l/sec water from the Reuss river to the Rotsee, and a mechanical wastewater treatment facility to serve 900 inhabitants was constructed. When no improvement in water quality occurred, a second plant to serve 7,300 inhabitants was built in 1933. Since 1974, no wastewaters have been discharged into the lake, and the quality of the Reuss has improved due to new wastewater treatment facilities in the city of Lucerne. Investigations of the Rotsee in 1920-23, 1930, 1949, and 1969-70 revealed no improvement in water quality, but this trend was reversed in 1978-79. Whereas in 1970 500 mg phosphorus/cu m was measured during spring turnover, this level was below 100 mg phosphorus/cu m in March 1981. Improvements were also seen in minimal visual depth and oxygen levels, while fish were able to survive in larger areas. Despite these improvements, the present phosphorus input is twice the desired level of 350 kg/yr for a 90-m-deep lake with a water retention time of 0.4 yr. (Gish-FRC)
W83-02504

ORGANIC CHEMICAL FIRE IN ILLINOIS: EMERGENCY RESPONSE AND CLEANUP,
Illinois State Environmental Protection Agency, Springfield.
W. H. Busch, and J. Reinkes.
Civil Engineering (New York), Vol 52, No 9, p 62-65, September, 1982. 1 Tab.

Descriptors: *Agricultural chemicals, *Chemical wastes, *Soil contamination, *Organic compounds, Fires, Emergencies, Pesticides, *Chemical wastewater, Spills, Waste disposal, Waste treatment, Wastewater treatment, Water pollution prevention, Neutralization, Soda ash, Activated carbon, Degradation, Soil treatment, Lagoons, Hillsboro, *Illinois.

A fire at the Hewitt-Ware Feed and Supply Company agricultural chemical warehouse at Hillsboro, Illinois, on April 23, 1980, produced 250,000 gal of contaminated firefighting water as well as contaminated fire debris and soil. Twenty-one chemicals of differing toxicity had been stored in the warehouse. Immediate damage to the groundwater and surface water was mitigated by the natural swales in the land and the hastily constructed retention dams, which contained the waste, and by the underlying layer of low-permeability blue clay. Contaminated water discharged through storm sewers to a nearby creek was temporarily contained by a bentonite-lined sand bag dam. This water was pumped into a quickly constructed 300,000 gal membrane-lined pit adjacent to the creek for storage and subsequent treatment with soda ash and activated carbon (1000 mg per liter dose). Because of the complex mixture of chemicals and difficulties with analysis, 72 hour static bioassays with fingerling perch were used to determine if the water had been sufficiently detoxified to return to the creek. Sludge produced from the flocculation process was disposed of in a landfill. Unburned products were placed in sealed drums and burned drums were placed in overpack drums for disposal in a hazardous waste landfill. The most heavily contaminated soil was removed to the landfill. The remainder of the debris-cleared site was treated with soda ash and powdered activated carbon to absorb toxic substances and encourage natural degradation processes. (Cassar-FRC)
W83-02516

RESTORATION OF THE CENTRAL LAKES: BALDEGGERSEE, HALLWILERSEE, AND SEMPACHERSEE. GENERAL OVERVIEW (DIE SANIERUNG DERMITTELLANDSEEN: BALDEGGERSEE, HALLWILERSEE UND SEMPACHERSEE. ALLGEMEINER UBERBLICK),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
P. Baumann.
Wasser, Energie, Luft, Vol 74, No 1/2, p 13-14, January/February, 1982. (No English Summary).

Descriptors: *Eutrophic lakes, *Lake restoration, *Phosphorus removal, *Water pollution control, *Planning, Aeration, Water circulation, Wastewater treatment facilities, Sludge disposal, Agriculture, Rural areas, Regulations, *Switzerland, Sempachersee.

Methods of restoring the eutrophic central Swiss lakes Baldeggersee, Hallwilersee, and Sempachersee are described, using as an example a four-step plan developed for Sempachersee. The principal cause of eutrophication is phosphorus; the annual phosphorus load of Sempachersee is 15 tons (7 tons from wastewater treatment plants and urban and rural areas not served by these facilities, 7 tons from agricultural areas, and 1 ton from the atmosphere and precipitation), whereas it should lie below 4 tons. The first stage of the plan is directed toward urban areas, where wastewater treatment plants which phosphorus precipitation are in use. The boroughs are obligated to ensure that all households are hooked up to the sewers, while the cantons are responsible for monitoring the quality of treated wastewater released into the lake. Rural areas, dealt with in stage two of the plan, often release raw or partially treated wastewaters containing phosphorus to the lake. The discharge points must be located and treated individually. For the agricultural areas (stage three), an assessment was made in 1979 of agricultural pollution of the lake's catchment area with emphasis on phosphorus, and in 1981 all farmers in this area received general and individually oriented information on this subject. The fourth stage concerns measures conducted within the lake: aeration, artificial circulation in winter, and extraction of 1.1 cu m/sec of polluted water from a depth of 80 m. None of these measures are yet in effect. (Gish-FRC)
W83-02558

VALUE OF INDIVIDUAL HOUSEHOLD WATER SUPPLIES IN THE MAINTENANCE PHASE OF A SCHISTOSOMIASIS CONTROL PROGRAMME IN SAINT LUCIA, AFTER CHEMOTHERAPY,
National Inst. for Medical Research, London (England). Div. of Parasitology.
P. Jordan, G. O. Unrau, R. K. Bartholomew, J. A. Cook, and E. Grist.
Bulletin of the World Health Organization, Vol 60, No 4, p 583-588, 1982. 5 Tab, 11 Ref.

Descriptors: *Public health, *Potable water, *Sanitation, *Human diseases, *Developing countries, Rural areas, Benefits, Cost analysis, Infection, Drinking water, Water supply development, Sanitary engineering, *Saint Lucia, *Schistosomiasis.

The effect of providing individual household water supplies and community laundry shower units on the transmission of Schistosoma mansoni was studied in five villages in Richefond valley in Saint Lucia. Between 1970 and 1975, the incidence of new infections among children 0-10 years of age declined from 31 to 12.6%. From 1975 to 1977, chemotherapy with oxamniquine was offered to persons still found to be infected. Transmission of the disease remained low for the next four years, with no sign of an increase, despite poor sanitation in the villages. It was concluded that properly maintained drinking water supplies contribute substantially to the reduced transmission of schistosomiasis in a comprehensive control program. Sporadic new infections were found mostly among children, but these were associated with minimal morbidity. Detailed cost records for maintaining water supplies and providing chemotherapy programs in the villages were kept. (Geiger-FRC)
W83-02561

URGENT PROBLEMS OF CONSERVATION AND RATIONAL USE OF WATER RESOURCES,
A. B. Avakyan, and V. S. Kaminskii.
Hydrotechnical Construction, No 2, p 148-152, February, 1980. 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 2, p 24-26, February, 1980.

Descriptors: *Reservoirs, *Water management, *Water reuse, Water quality control, Wastewater treatment, Self-purification, Industrial wastewater, Municipal wastewater, Water conservation, Recycling, Regional planning, Zero-discharge, Planning.

Conservation and improvement of water quality is an increasing concern of water resource development planners in the USSR. Reservoirs decrease river current velocities, self-purification, mixing, and dilution of wastes. Protection of water bodies must consider not only the water itself, but processes occurring in the drainage basin and in the littoral zone. The current water quality policies in the USSR emphasize industrial use of closed water supply cycles and zero-waterand zero-waste technologies. In 1976 recycled water amounted to 68% of total water used in industry. Complex technical problems must be solved before 100% water recycling is possible: handling of mineral pollutants, sufficient disinfection of municipal wastewaters, and control of farm runoff. Planning for preserving water quality of reservoir systems should be on a

regional basis, recognizing that distinctly different masses of water can exist within a single reservoir. Possible means of altering water bodies include: engineering measures (embankments, etc.) to create independent regimes, removal of excess organic matter or addition of fertilizers to change the trophic state, aeration of water, creation of water protection and buffer zones, and controlled formation of ecosystems. To avoid conflict among the different branches of the economy (fisheries, recreation, agriculture, industry, etc.) it is important to coordinate water quality improvement projects. (Cassar-FRC)
W83-02623

THE ROLE OF BENTONITE IN SOIL SEALING APPLICATIONS,
International Minerals and Chemical Corp., Des Plaines, IL.
G. R. Alther.
Bulletin of the Association of Engineering Geologists, Vol 18, No 4, p 401-409, November, 1982. 3 Fig, 6 Tab, 14 Ref.

Descriptors: *Bentonite, *Groundwater pollution, *Water pollution control, *Waste dumps, Infiltration, Permeability, Covers, Liners, Hazardous wastes, Solid wastes.

The types of bentonite, installation practices, and testing methods employed when using bentonite in soil sealing applications are considered. Leachates are generated in solid waste disposal sites when water is allowed to infiltrate the site. The degree of groundwater contamination is related to the degree of leaching, and depends on the hydrogeology of the area and on the attenuation capacity of the soil. Swelling bentonite has gained prominence in waste isolation projects in the last few years. By admixing swelling bentonite with soils of high permeability, the coefficient of permeability can be drastically reduced. The bentonite is either deposited over the soil as a pure blanket and covered with soil, or mixed into 5 to 15 cm of soil as a mixed blanket. However, the pure blanket method is subject to puncture and subsequent leaking. In addition to landfill liners, slurry trenches may also be constructed using bentonite slurry to seal off a waste site from groundwater. The compatability of bentonite with wastes is good, and the swelling of bentonite can be increased by adding a polymer of the sodium polyacrylate and acrylonitrile type. It is very important, however, that the bentonite in all sealing applications be prehydrated with fresh water upon installation to improve its resistance to contaminants. (Baker-FRC)
W83-02662

EVALUATION OF THE SUCCESS OF NUTRIENT-ELIMINATION MEASURES IN WATERS WITH A HIGH NUTRIENT CONTENT (BEWERTUNG DES ERFOLGES VON NAHRSTOFFELIMINIERUNGSMASSNAHMEN AN STARK BELASTETEN GEWASSERN),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
G. Klein, and R. Kuhn.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 136-143, June, 1982. 10 Fig, 4 Ref.

Descriptors: *Nutrient removal, *Lake restoration, *Evaluation, *Water use, *Phosphorus removal, Eutrophic lakes, Grunewaldseen, Berlin, *Federal Republic of Germany, Phoshates, Oxygen, Biomass, Algae, Phytoplankton, Oxidation-reduction potential, Seasonal variation, Chlorophyll, Water Quality.

Elements necessary for a successful program of investigation to document the effects of surface-water restoration are discussed with particular reference to the goals for water use. The lower Grunewaldseen in Berlin (Federal Republic of Germany) are used as an example. The input of nutrients into the Schlachtensee with water from the Wannsee is largely responsible for marked eutrophication. The effect of a phosphorus (P) elimination plant for lake restoration will be assessed over a two-year period. The influence of climate and sources of nutrients other than Wannsee water is important for the assessment of the program's effect on P levels. It was assumed that after restoration the amount of mobile P in the hypolimnion will be limited during summer stagnation when oxygen consumption in the sediment-water contact zone will be slowed and that reduced P input in fall will not compensate for P precipitation during circulation as much as before. The observed reduction of nitrogen in Schlachtensee would result in a change in phytoplankton population distribution if the program were successful, as well as a reduction in primary production and an associated improvement in oxygen balance and water quality. (Gish-FRC)
W83-02688

DISTURBANCE OF WATER PURIFICATION PROCESS BY ALGAE, ESPECIALLY DURING THE INFILTRATION OF A BIOLOGICALLY ACTIVE SURFACE WATER (BEEINTRACHTIGUNG DER WASSERREINIGUNG, INSBESONDERE BEI DER INFILTRATION EINES BIOLOGISCH HOCHAKTIVEN OBERFLACHENWASSERS),
Dortmunder Stadtwerke A.G. (Germany, F.R.).
K. Schmidt.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 15, No 3, p 143-151, June 1982. 14 Fig, 11 Ref.

Descriptors: *Artificial recharge, *Induced infiltration, *Algal control, *Drinking water, *Rivers, Ruhr river, *Federal Republic of Germany, *Sand filters, *Self-purification, Flow velocity, Storage reservoirs, Phosphorus elimination, Flocculation, Potassium compounds, Biomass, Primary productivity, Algal growth, Chlorophyll a, Slow sand filters, Groundwater recharge.

Impairment of water purification by algae occurred in the middle Ruhr area of the Federal Republic of Germany where drinking water was obtained through artificial groundwater recharge. Algae developed in slow sand filters when biologically active river water was used for recharge. The Dortmund facility avoided the problem by using a coarse gravel filter followed by aeration cascades. These are operated intermittently to avoid algal growth in the infiltration basin--a slow sand filter. Finally, the water runsthrough a 50-m long underground passage where it remains less than 12 hr. Methods that can be used to prevent algal mass development during artificial recharge include intermittent filter operation on a 24-28 hr rhythm, phosphorus elimination by flocculation, and continous dosing of 1 to 1.5 mg/liter of potassium permanganate. (Small-FRC)
W83-02717

FEASIBILITY OF INACTIVATING PHOSPHORUS WITH ALUMINUM SALTS IN BALL POND, CT,
Connecticut Agricultural Experiment Station, New Haven.
W. A. Norvell.
Bulletin 806, September 1982. 10 p, 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Phosphorus, *Aluminum sulfate, *Alum, *Eutrophication, *Lake restoration, Algal growth, Nitrogen, Retention time, Alkalinity, Hydrogen sulfide, Fish populations, Sediment-water interface, Oxygen demand, *Connecticut, Ball Pond.

Ball Pond's characteristics and watershed suggest that reduced phosphorus (P) concentrations would greatly restrict algal growth, reduce eutrophication and increase the lake's value as a recreational and fishery resource. The study's objectives were to confirm the lake's suitability for treatments to inactivate P and to determine the forms and amounts of P susceptible to inactivation, the proportion of P from external vs. internal sources, the choice of aluminum (Al) salts and application rates, how much of the lake would need treatment, and if treatment would damage the fish population. Field studies confirmed its eutrophic status: in 1979, nitrogen (N) and P were fairly high, hypolimnetic oxygen was consumed rapidly, hydrogen sulfide was found in most of the hypolimnion, and chlorophyll-a concentrations and algal numbers were high. Ball Pond is well-suited to treatment by aluminum salts to inactivate phosphorus. Most P in the lake becomes concentrated in the hypolimnion during summer stratification and a large proportion is present as easily precipitated inorganic phosphate. Treatment of the hypoliminion with liquid alum in late summer or early fall would probably remove one-half of the lake's total P, an amount greater that the estimated annual supply for external sources. Applying about 85,000 kg of liquid alum would provide the desired addition of Al. Benefits from treatment should be relatively long-lasting because of the large fraction of phosphorus removed and the five-year water retention time. In late summer and fall the form of P most susceptible to inactivation is concentrated in a region where desirable fish species would not be present. (Atkins-Omniplan)
W83-02718

FURTHER ACTION BY THE CANTONS. AARGAU CANTON (DAS WEITERE VORGEHEN DER KANTONE. KANTON AARGAU),
Kanton Aargau, Aarau (Switzerland). Abt. Gewasserschutz.
E. Marki.
Wasser, Energie, Luft, Vol 74, No 1/2, p 14-15, January/February 1982. (No English Summary).

Descriptors: *Lake restoration, *Lake sediments, *Aeration, *Phosphorus removal, *Project planning, Water pollution control, Water Quality control, Costs, *Switzerland, Hallwilersee, Fertilizers, Agriculture, Aerobic conditions, Water circulation, Deep water.

The efforts of the Aargau canton, Switzerland, to reduce pollution in the Hallwilersee are described. Aargau is only partially responsible for the cleanup, sharing planning and costs with the Lucerne canton. Earlier efforts were centered on keeping wastewater pollution out of the lake, and this goal has almost been reached since 1964, when the Seengen wastewater treatment facility became operational. Phosphorus is not revoved by chemical precipitation, but by drainage below the lake outlet. The two main sources of phosphorus in the Hallwilersee, apart from the inflow from the Baldeggersee, are eroded material from cultivated land and redissolved lake sediment. The canton is presently eliminating phosphorus from sediment almost entirely by the year-round introduction of oxygen into the deep water at the rate of 6-10 g/1,000l water. This oxygenation also allows normal fish life and breeding. Pollution with unused fertilizer from arable land cannot be cured completely with technological means; different fertilization processes must be adopted, and more land susceptible to erosion must be turned over to pasture. A competition set up by the Argau and Lucerne cantons for projects for the restoration of the Hallwiler-, Baldegger-, and Sempacherseen showed that there are several methods of oxygenating deep water. The one selected for pilot study, based on cost and projected durability, was the Tanytarsus procedure. Operation is expected to begin in 1985. Goals for the project are aeration of the hypolimnion with forced circulation in winter; at a permanent phosphorus content of 11.4 tons/yr, this is expected to produce constantly aerobic conditions within six years. (Gish-FRC)
W83-02758

FURTHER ACTION BY THE CANTONS. LUCERNE CANTON (DAS WEITERE VORGEHEN DER KANTONE. KANTON LUZERN),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
P. Baumann.
Wasser, Energie, Luft, Vol 74, No 1/2, p 15-16, January/February, 1982. (No English Summary).

Descriptors: *Lake restoration, *Aeration, *Project planning, *Costs, *Pilot plants, *Switzerland, Baldeggersee, Sempachersee, Hallwilersee, Oxygen, Construction costs, Economic aspects, Government supports, Water pollution control, Water quality control, Water circulation, Deep water, Water transfer.

The Lucerne (Switzerland) canton's plans for the restoration of the Baldeggersee, Sempachersee,

and Hallwilersee (for which it is jointly responsible with the Aargau canton) are described. A canton-supported competition to obtain projects for this purpose turned up a simple and inexpensive procedure for deep-water aeration and forced circulation. The Tanytarsus procedure requires a distribution station on the lake bank, from which pure oxygen is dispensed to the deep strata through a pipeline network anchored to the lake bed. There is no need for large, unsightly structures. Tanytarsus is being tested in the Baldeggersee, chosen as the experimental lake because of its sheltered position (it has no ship traffic or other outside disturbances), because its depth lies between that of the other two lakes, and because current measurements have been made there. If the test is successful, the procedure will also be used in the Sempacher- and Hallwilerseen; it is therefore important that the cantons of Lucerne and Aargau cooperate and share costs equitably. Test aeration was scheduled to begin in the spring of 1982 and last about one year; installations were to be constructed so that they could form part of a permanent facility. Draining off of deep water is not forseen for Baldeggersee, but a feasibility study for this is to be conducted for Sempachersee. An alternative project for Sempachersee would involve connecting the lake with the Reuss river, so that water could be transported back and forth. The height difference between the lake and the river would permit the construction of a power station. The water renewal time of the lake would theoretically be reduced from 17 to 4-6 years. Improvement in water quality would result even without aeration. This project would cost about 36 million Francs. The high cost, together with legal considerations, are barriers to the realization of this plan, and deep-water aeration needs to be instituted without delay. (Gish-FRC)
W83-02759

CUBELLES THERMAL POWER PLANT-A NEW SOLUTION FOR THE INTAKE AND DISCHARGE OF COOLING WATER (CENTRA TERMICA DE CUBELLES-UNA NUEVA SOLUCION PARA LA TOMA Y DESCARGA DE AGUA DE REFRIGERACION),
Madrid Univ. (Spain).
For primary bibliographic entry see Field 8A.
W83-02795

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MODEL SELECTION IN MULTIOBJECTIVE DECISION MAKING FOR RIVER BASIN PLANNING
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
L. Duckstein, M. Gershon, and R. McAniff.
Advances in Water Resources, Vol 5, No 3, p 178-184, September, 1982. 2 Fig, 4 Tab, 34 Ref.

Descriptors: *Water resources development, *River basins, *Planning techniques, Decision making, Management, Model studies, ELECTRE, Compromise programming, Multiattribute utility theory, Santa Cruz River, *Arizona.

Appropriate model selection among three alternative multiobjective techniques was explored using an example of river basin planning. The site of the study was the main stem of the Santa Cruz River near Tucson, Arizona. The three techniques are ELECTRE, compromise programming and multiatribute utility theory (MAUT). Important questions in the selection process concern the type of data required, the necessary amount of interaction between the decision maker and analyst, and the nature of the problem. Such characteristics are used as criteria to demonstrate whether or not a particular model can be successfully applied. Based on the computations obtained it is concluded that compromise programming is the most appropriate model for application to this problem. In compromise programming and in the ELECTRE procedure a scaling procedure is used to convert qualitative to quantative data, while MHUD requires development and assessment of a utility function. Compromise programming can be applied to both discrete and continuous data. Differences in the application of the discordance concept cause differences in the consistency of results obtained. All the methodologies tested were fairly robust with respect to changes in parameter values. (Baker-FRC)
W83-02650

6B. Evaluation Process

THE ECONOMIC EFFICIENCY OF FLOOD PLAIN DEVELOPMENT,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6F.
W83-02477

THE ECONOMIC IMPACTS OF ALTERNATIVES AND CONTINGENCIES RELATING TO THE 1978 DECISIONS OF THE MONTANA BOARD OF NATURAL RESOURCES ON WATER RESERVATIONS IN THE YELLOWSTONE BASIN,
R. J. McConnen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186460, Price codes: A02 in paper copy, A01 in microfiche. Montana Water Resources Research Report No 126, Bozeman, January 1983. 21 p, 2 Fig, 3 Tab, 13 Ref. OWRT A-125-MONT(1), 14-34-0001-0128.

Descriptors: *Linear programming, *Water allocation(Policy), *Irrigation, *Return flow, Irrigation efficiencies, Water law, Runoff low flow, Yellowstone River, Return flow coefficients, Winters doctrine, Alternative allocations, *Montana.

A linear programming (L.P.) model for the Yellowstone Basin which is partitioned into nine sub basins and six time intervals has been developed and the data required to use the model has been collected. One of the major problems which was solved before the general L.P. model could be used was to develop realistic return flow coefficients for each of the nine sub basins and for each of the six time intervals. The return flow coefficients were estimated in a manner which was consistent both with the general theory about return flows and the seasonal pattern of stream flow which is generated within each sub-basin for each of the six time intervals. The methodology used to generate estimates of return flow coefficients was designed to be a general methodology and should be usable in many other water resource situations. The general L.P. model will be used to deal with a series of policy related issues including the impact of increased efficiencies on late season flows, especially during low flow years. The impact of alternative allocations of the Yellowstone water will be analyzed along with the impact of the levels of prices received on the marginal value of water.
W83-02493

ECONOMIC ISSUES IN RESOLVING CONFLICTS IN WATER USE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W83-02501

VALUATION OF INTANGIBLES: THE CASE OF WATER QUALITY,
Massachusetts Univ., Amherst. Dept. of Agricultural and Resource Economics.
C. E. Willis, J. H. Foster, and K. Sewall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191874, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 133, Massachusetts University, Amherst, January 1983. 115 p, 9 Fig, 10 Tab, 37 Ref, 4 Append. OWRT B-076-MASS(1), 14-34-0001-9151.

Descriptors: *Water value, *Property value, Water pollution control, *Water quality, *Environmental quality, *Environmental protection, *Connecticut River Basin, Econometrics, Depreciation, Elasticity of demand, Land appraisals, Value, Economic development, Economic impact, Pollution effects, Market value, *Massachusetts.

The hedonic technique has been advanced in the last several years as an important research tool for assessing the value of environmental attributes not subject directly to market forces. In its most usual form, the method involves attempting econometrically to capture differential prices for homes due to variations in the environmental characteristics. It has been applied successfully for a variety of attributes--perhaps most notably the study of air pollution. However, the two case studies of water quality improvement reported in this study appear not to have increased prices paid for real property. The authors advance several possible reasons to explain the failure of the hedonic approach in these cases, including likelihood that prospective property purchasers may be unaware of specific water quality improvements and likelihood that changes in supply and demand for housing obscure the impact on price of amenity improvements.
W83-02732

RECREATION IN THE PERCEIVED COMMUNITY FUNCTION PERSPECTIVE,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
B. F. Blake, J. T. O'Leary, and M. B. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191932, Price codes: A03 in paper copy, A01 in microfiche. Purdue University Agricultural Experiment Station Bulletin No 351, November 1981. 37 p, 4 Fig, 4 Tab, 69 Ref, 2 Append. OWRT A-999-IND(8).

Descriptors: *Outdoor recreation, *Recreation facilities, *Community function, Recreation, *Attitudes, Public opinion, *Recreation demand, *Surveys, Evaluation, Social values.

This survey shows that the individuals judgments of the value of outdoor recreation facilities are multidimensional. The dimensions evaluated were (1) individualistic vs. community wide, (2) the change vs. stability continuum, and (3) the primary vs. secondary function. The data suggested that people used these three dimensions or yardsticks in judging the value of outdoor recreation. The overall value that people saw in outdoor recreational facilities was determined by how well outdoor recreation facilities simultaneously 'measured up' against all three of these yardsticks.
W83-02740

AN EVALUTION FRAMEWORK FOR ASSESSING VARIATIONS IN THE COSTS AND BENEFITS OF MUNICIPAL WATER CONSERVATION,
INTASA, Inc., Menlo Park, CA.
W. B. Betchart, F. Floridis, B. Jones, and S. Postel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191965, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, December 1981. 136 p, 14 Fig, 30 Tab, 45 Ref. OWRT C-00010-C (No 0485)(1), 14-34-0001-0485.

Descriptors: *Municipal water conservation, *Water conservation, Water supply savings, Wastewater treatment savings, *Community water conservation, Economics, *Cost-benefit analysis, *Engergy savings, Water resources planning, Conservation case studies, Net benefits.

A method is presented for quantifying municipal water conservation's costs and benefits to the community. Community characteristics such as population growth rates, ambient water supply temperature and water heater fuel type and price were examined to determine their influence on overall costs and benefits of municipal water conservation. Three case studies were performed to apply the method to 'real life' situations. Municipal water conservation was found to be an economically efficient water management strategy in diverse sets of circumstances. Although economically justifiable in many settings, the sources of economic

benefits varied greatly. In the case studies examined, water supply utility savings ranged from 1.4 to 20 percent of total dollar savings as a result of a water conservation program. Wastewater treatment savings ranged from 2.6 to 56 percent of total savings. Hot water energy savings were the most consistent savings component, comprising at least 40 percent of total savings in each of the case studies. Further findings indicate that communities with little or no excess capacity in its water supply and wastewater treatment facilities will find water conservation economically beneficial. Annual population growth rates and the water conservation economically beneficial. Annual population growth rates and the water demand and wastewater flow peak factors appear to substantially influence water conservation's net benefits to the community. The ambient water temperature and fuel price and type, which affect the cost of heating water to the temperature desired for use, appear to have more modest effects on the benefits of municipal water conservation. The level of water demand and wastewater flow reductions actually achieved by the water conservation program were found to have dramatic effects on the program's net benefits.
W83-02743

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RATE STRUCTURE ALTERNATIVES FOR UTILITIES,
J. J. Gall, and T. S. Catlin.
Public Works, Vol 113, No 6, p 39-43, June, 1982.

Descriptors: *Water costs, *User charges, *Sewage rate, Costs, Water conservation, Water use, Water metering.

As large scale system oversizing becomes less practical and as water conservation becomes more important, several new pricing policies for water service are becoming more popular. Service charges are fixed charges designed to recover the costs required to supply customers with meters, service lines and other billing expenses. Uniform rates ensure that all customers pay at an equal rate. Under increasing block rates, progressively larger increments of usage are sold at successively higher rates during the billing period. Increasing block rates are usually used where water conservation is of critical concern. Seasonal surcharges may be applied to the base water rate in areas where water becomes seasonally scarce. When a municipal water service provides water service to a neighboring community, it is best done under a contract. A high degree of correlation exists between water service charges and sewer rate structures. In the early 1970's, the EPA construction grants program forced changes in sewer rates methodology and required proportional charges for all users. Retail sewer rates are often based on infiltration and flow, which means greater costs for heavier water users. Some problems with direct measurements for retail charges exist in seasonal communities and places where non-returned use is high. Like water rates, wholesale sewer rates are often the same as, or multiples of, rates charged to retail customers, a system that ignores wastewater quality. Apportioning costs between wholesale and retail customers according to water quality considerations is discussed. (Geiger-FRC)
W83-02473

THE EFFECTS OF WATER CONSERVATION ON NEW WATER SUPPLY FOR URBAN COLORADO UTILITIES,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 3D.
W83-02500

SEEKING CONSUMERS COOPERATION IN THE FINANCING OF WATER SUPPLY (CONDITIONS PERMETTANT AUX CONSOMMATEURS A RESSOURCES LIMITEES DE PARTICIPER AU FINANCEMENT DE LEUR CONSOMMATION D EAU),
Caisse Centrale de Cooperation Economique, Paris (France).
H. Le Masson.
Aqua, No 3, p 263-266, 1981.

Descriptors: *Water conveyance, *Maintenance costs, *Operating costs, *Metropolitan water management, Economic aspects, User charges, Water distribution, Developing countries, Investment, *Africa, Carribean.

A procedure which can be used to finance the maintenance and operating costs of the water supply service by consumers even in capital-poor countries is presented. First, the responsibilities of the government and of the water supply company must be well defined. Second, the water supply company must have improved organizations and management adapted to local conditions. The different characteristics of urban, town, and village water systems must be kept in mind in planning. (Small-FRC)
W83-02634

DRINKING WATER AND ITS PRICING (EAU POTABLE ET TARIFICATION),
Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
G. Facy.
Aqua, No 3, p 271-273, 1981.

Descriptors: *Water conveyance, *Water distribution, *Water costs, *Water management, Resources management, Public policy, Water policy, Water demand, Water supply, Public relations, Policy making.

Water industry data are needed in order to properly manage water supplies and determine reasonable charges for water use. Reasons for assembling this information are different in every country and depend on organizational structure and the responsibilities of the national water industry. A comprehensive survey of water resources should be prepared from all information sources including the government, water supply associations, and scientific and research institutes. Total supply figures for a country are not sufficient. Data are needed on supply areas, political districts, and catchment areas. Long-term surveys are necessary for systematic planning to meet future water demand. Occasional specific reports are not sufficient. An active information policy is suggested for government institutions and private organizations, to provide the public with economic and technical information on the nation's water supply. The reasons for variations in water charges such as different patterns of consumption and different types of charges should be explained to the public. (Small-FRC)
W83-02652

MUCH MORE TO RATES THAN TRADITION,
Camp, Dresser and McKee, Inc., Boston, MA.
C. Woodcock.
Water/Engineering and Management, Vol 129, No 11, p 24-25, 1982.

Descriptors: *Water rates, *Pricing, Decision making, Management, Water supply, Economic aspects, Municipal water supply.

In an effort to update the water-rate structure for a given municipality, a study was made to determine what procedures had been used in the past and what the best approach to the future might be. In the past this municipality has used a three-block, declining-rate schedule with minumum charges and allowances. Various methods have been developed over the years to determine an optimum water-rate schedule for any given community. Such solutions have extolled the virtues of marginal cost pricing, increasing block rates, decreasing block rates, uniform rates, life-line rates, and others. Economic realities change rates, and local economic conditions should be considered in making any changes. Protecting the small water user must be kept in mind. Deviations from pure cost-of-service principles in order to meet the operating goals of the water utility are valid considerations as well. Existing contracts which may have some clauses concerning how a municipality will charge for its water use must be examined. (Baker-FRC)
W83-02781

6D. Water Demand

IMPACT EVALUATION OF INCREASED WATER USE BY AGRICULTURE IN MICHIGAN,
Michigan Agricultural Experiment Station, East Lansing.
J. F. Bartholic, R. L. Cook, F. M. D'Itri, D. B. Knezek, and M. L. Vitosh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-190447. Price codes: A09 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, Michigan State Univ., East Lansing, October 1982. 194 p, 49 Fig, 29 Tab, 131 Ref,1 Append. OWRT A-106-MICH(1), 14-34-0001-9024.

Descriptors: *Irrigation, *Crops, *Groundwater, *Recharge, *Riparian rights, Ecosystem, Water planning, *Michigan, Water law, Agricultural production, Corn, Soybeans, Great Lakes, Lakes, *Water use, *Consumptive use.

Irrigation, scientifically regulated, can increase the productive capacity of sandy soils. Probably 750,000 acres will be irrigated in Michigan by the year 2000. Most of the increase will be in central, southwestern, and southern Michigan on corn and soybeans, with the increased water used to come largely from underground sources. A need for further studies in surface supplies as related to soil characteristics and moisture modeling and crop coefficient studies is evident. Excessive water removal from small streams and shallow lakes during summer may lessen flow rates and seriously affect animal and plant activities in the water and on stream and lake bottoms. It may be advisable to limit water removal accordingly. Consumptive versus non-consumptive water use must be considered. Domestic use is nonconsumptive but contamination may be a hazard. In Michigan a license is not required for withdrawal of water for irrigation but the amount withdrawn must not exceed 'reasonable use', resulting disputes to be settled by a court of law. Navigable streams in Michigan may not legally be a source of irrigation; but if the 'reasonable use' doctrine is adhered to, a riparian owner may usually use such waters.
W83-02479

ECONOMIC ISSUES IN RESOLVING CONFLICTS IN WATER USE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. L. Gray, and R. A. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-189969, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Institute Completion Report No 119, Colorado State University, Fort Collins, February 1983. 36 p, 17 Ref. OWRT A-037-COLO(1), 14-34-0001-8006.

Descriptors: *Economic aspects, *Water use, Value, *Prices, *Water allocation, Water resources development, Water management, *Colorado, Decision making, *Alternative uses, *Competing use.

One central and recurring theme underlies the concern of many agencies involved in water development and allocation decisions in Colorado. That theme is conflict in the use of economically scarce water supplies and appropriate means of resolving such conflict. One key economic ingredient in resolving conflicts among alternative uses is the value of water. An extensive literature search indicates that policy makers are not being provided consistent, comparable estimates of the social and economic significance of water in alternative uses. The reason is that water resource analysts have apparently reached no consensus on a systematic framework within which to estimate water values in the absence of observed market prices. The explanation lies in the failure of analysts to fully appreciate problems associated with the physical characteristics of the resource which may lead to

significant economic interdependencies, differences in the perspective taken in estimating water values, inadequately or inappropriately conceived concepts of use, variations in the techniques of analysis employed, and other factors. A conceptually consistent framework for valuing water is set forth. In addition two widely used analytical methods for valuing water are discussed. The residual imputation technique is found to be generally acceptable. However, the increasing reliance on valuation through the 'value-added approach' should be discouraged.
W83-02501

THE CREST DISPUTE: A MEDIATION SUCCESS,
Institute for Environmental Mediation, Seattle, WA.
V. C. Huser.
Environment, Vol 24, No 7, p 18-20, 36, September, 1982.

Descriptors: *Water resources development, *Planning, *Columbia river estuary, *Management, Estuaries, Estuarine environment, Port facilities, Environmental effects, Design criteria, Mediation.

Opposing priorities concerning appropriate use of the Columbia River Estuary and its shorelines in Clatsop County, Oregon, were recently settled through mediation. The mediation process was conducted by CREST (Columbia River Estuary Study Taskforce). By late 1980 the dispute had centered on the development and/or preservation of five specific sites in the estuary, and mediation was begun. Before negotiations of the issues could begin, ground rules had to be established. How any agreement would be achieved and formalized rather than what the agreement would contain were the major issues at the start of mediation. A matrix was proposed for each site, containing a detailed listing of each site, options for developing or maintaining that site, and criteria for each of the options. At this point the opposing sides were then able to engage in trade-offs. By the conclusion of the mediation sessions three levels of agreement were reached: an agreement on findings containing factual information that all parties would use in their deliberations and permit applications; an agreement on development designations which identified specific areas to be developed; and an agreement on subarea policies, which is a key element of the final agreement detailing the conditions under which development could occur in the appropriate areas specified in the agreement on development designations. (Baker-FRC)
W83-02532

THE DRAKENSBERG PROJECT: WATER AND POWER FOR SOUTH AFRICA,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
T. P. C. Van Robbroeck.
Civil Engineer in South Africa, Vol 24, No 8, p 343-345, 347, 350-352, August, 1982. 8 Fig, 2 Tab, 6 Ref.

Descriptors: Water resources development, *Water supply, *Dams, Reservoirs, Planning, Management, Cost analysis, Decision-making, *South Africa, Drakensburg Project.

The planning of the Tugela-Vaal Scheme is outlined with particular reference to the Drakensberg Project, a major undertaking combining an 11 cubic meter/second inter-basin water transfer with a 1,000 MW pumped storage hydroelectric installation. Cooperation between the authorities responsible for water and those responsible for electricity supply resulted in a cost saving to the country of R50 million. The basis of this joint participation in the financing and construction of the scheme is described. Both phases of the scheme are now virtually in full operation, with more than 650 million cubic meters of water already stored at Sterkfontein Dam, ready to help towards overcoming the next drought. (Baker-FRC)
W83-02647

THE HUNDRED-YEAR EFFORT TO SECURE HONG KONG'S WATER SUPPLY (HUNDERTJAHRIGES BEMUHEN UM HONG KONG'S WASSERVERSORGUNG),
For primary bibliographic entry see Field 3B.
W83-02762

MORE CONFIDENCE IN PLANNING THROUGH CAPACITY STANDARDS FOR WATER SUPPLY SYSTEMS (MEHR PLANERISCHE SICHERHEIT DURCH DIE ABLEITUNG VON KAPAZITATSBEMESSUNGSGRUND LAGEN FUR DIE WASSERWIRTSCHAFT),
Munich Univ. (Germany, F.R.).
H. Fendt, and J. Ruhland.
Wasserwirtschaft, Vol 72, No 7/8, p 293-296, July/August, 1982. 4 Fig, 10 Ref. (English Summary).

Descriptors: *Water supply, *Stochastic process, *Water demand, Municipal water, Mathematical equations, Mathematical studies.

A method to derive capacity planning standards for water supply systems is developed. Daily water demand is regarded as a stochastic variable. The water supply system is said to fail if, on a day-to-day basis, the demand, the minimum capacity requirements can be derived immediately, once the maximum probability of failure that is acceptable has been decided upon. Employing quantitative risk analysis, this distribution function can be derived from historic data. The procedure for outlining the case of a large urban public utility company is cited. (Baker-FRC)
W83-02763

6E. Water Law and Institutions

RESPONSIBILITY FOR RUNOFF CONTROL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
E. J. Rhomberg, and J. M. Mason, Jr.
Public Works, Vol 113, No 11, p 60-62, November, 1982. 4 Ref.

Descriptors: *Storm water, *Runoff, *Legislation, Legal aspects, Urban runoff, Water quality control, Water pollution control, Flood control, Drainage districts, Drainage, History, Ordinances, Building codes, Water law, Natural flow doctrine, Reasonable use, Civil law, Common enemy rule.

Legislation concerning control of storm water runoff can be traced back to the Commerce Clause of the Constitution's first article, which, broadly interpreted, would have given Congress power to regulate any activity. Several laws proved unworkable with respect to storm water discharges: Rivers and Harbors Act of 1899, Public Health Service Act of 1912, the Oil Pollution Act of 1924, and the Federal Water Pollution Control Act (FWPCA) of 1948. Later legislation included amendments to the FWCPA in 1956 and 1961, the Water Quality Act in 1965, and the Clean Water Restoration Act of 1966. The National Environmental Policy Act of 1969 was a significant law. Its most important provision was the requirement for environmental impact statements. Further amendments to the FWPCA in 1972 and 1977 regulated discharges into all waters, not just navigable waters. Aid to municipalities was provided by the Flood Control Acts of 1938 and 1960. Early drainage laws were aimed at increasing the amount of arable land and eliminating waterborne diseases. More recent laws are also concerned with harmful effects on groundwater and wildlife. Existing rules on surface runoff drainage are the common enemy rule, natural flow rule (a.k.a. civil law rule), and the reasonable use rule. Municipalities have no duty to construct storm drainage systems, although some states have imposed this responsibility. Subdivision laws shift the requirement for storm drainage to the developer. Subsequent maintenance fo the facilities is a subject of controversy. Municipal planning groups have considerable control over drainage through zoning and approval of development plants. Drainage districts, established as early as 1839, have powers varying with each state. Other forms of legislation affecting storm water runoff are zoning ordinances, building codes, and plumbing and sewer ordinances. (Cassar-FRC)
W83-02467

IMPACT EVALUATION OF INCREASED WATER USE BY AGRICULTURE IN MICHIGAN,
Michigan Agricultural Experiment Station, East Lansing.
For primary bibliographic entry see Field 6D.
W83-02479

EVALUATION OF THE RESULTS OF DRINKING WATER STUDIES ACCORDING TO APPENDIX 1 TO PARAGRAPH 3 OF THE DRINKING WATER ORDINANCE (AUSWERTUNG DER ERGEBNISSE VON TRINKWASSERUNTERSUCHUNGEN GEMASS ANLAGE 1 ZU PARAGRAPH 3 DER TRINKWASSERVERORDNUNG),
Baden-Wuerttemberg Landesanstalt fuer Umweltschutz (Germany, F.R.). Inst. of Seenforschungs Fischereiwesen.
For primary bibliographic entry see Field 5F.
W83-02618

A PUBLIC POLICY FOR HAZARDOUS WASTES,
Hofstra Univ., Hempstead, NY. School of Law.
W. R. Ginsberg.
Annals of the New York Academy of Sciences, Vol 387, p 39-45, 1982. 23 Ref.

Descriptors: *Hazardous materials, *Public policy, Waste disposal, Land disposal, Administration, Cost analysis.

Any comprehensive public policy directed to the problem of hazardous wastes must evolve from an understanding of its nature and scope, will require federal action, and will break new legal and governmental ground. It is estimated that 56 million metric tons of hazardous wastes are generated in the US each year. Major omissions in the hazardous waste policies at present have been highlighted by the recent experiences at Love Canal. The problem of paying for clean-up of hazardous waste sites has been borne, in some cases by area residents and in other cases by the public at large as industries generating the wastes have simply passed along the costs of clean-up to the consumer. Ways in which this charge might be shifted to the companies responsible for the wastes are explored. (Baker-FRC)
W83-02653

MAKE APPLICATIONS ACCORDING TO THE STATE WASTEWATER TAX LAWS ON TIME (DIE ANTRAGE NACH DEN LANDES-ABWASSERABGABENGESETZEN RECHTZEITIG STELLEN),
H. Keune.
Wasser, Luft und Betrieb, Vol 25, No 7/8, p 20-21, July/August, 1981. 2 Ref. (No English Summary).

Descriptors: *Water law, *Effluent charges, *Pollution taxes, Wastewater treatment, *Water pollution control, *Federal Republic of Germany, Settleable solids, Settling basins, Taxes, Legal aspects, Pollutant identification, Water quality control, Water quality standards.

Various deductions permissible under the Federal Republic of Germany's Wastewater Tax Law (WTL) are discussed. The deductions must be applied for in writing, and the various states have regulations governing the conditions under and time periods for which applications are granted. A reduction in units of pollution (UP) for which tax must be paid can be applied for by municipalities or industrial firms who possess a settling pond as a final treatment step attached to their wastewater treatment facility. As far as settleable solids are concerned, the various states have different rules regarding the use of gravimetry or volumetry for determining UP. Some states (e.g., Niedersachsen and Schleswig-Holstein) determine the number of UP gravimetrically at the taxpayer's request if the number of cu m/yr is more than five times as great

as the number of tons of dry matter/yr; other states (e.g., Hamburg, Saarland) only determine UP under these conditions for settleable solids with an organic matter content weight of less than 10%. Saarland adds that physical impairment of the receiving stream and impedance of maintenance thereof must be taken into acount when making a decision in this matter. Deductions for initial pollution of waters are not covered by law in some states (Baden-Wurttemburg, Niedersachsen); in others, initial pollution is determined on the basis of mean concentration and dilution factor of the water removed under consideration of expected changes in the quality of the water body from the which water was removed during a predetermined period not exceeding five years. If the state has set standards for initial pollution, these are adhered to; otherwise, initial pollution is individually determined. (Gish-FRC)
W83-02786

6F. Nonstructural Alternatives

THE ECONOMIC EFFICIENCY OF FLOOD PLAIN DEVELOPMENT,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and W. L. Miller.
Water Resources Research Center Technical Report No 141, Purdue University, West Lafayette, Indiana, May 1982. 84 p, 7 Fig, 52 Ref.

Descriptors: *Flood plain management, *Flood plain zoning, *Flood insurance, *Economic aspects, Flood plains, Risks, Insurance, *Indiana, Logansport.

This study examines resource allocation in the flood plain. The objectives included the development of a theoretical framework and the use of an empirical case study to explore the extent of overallocation of resources in flood prone areas and to access alternative policies to correct this problem. Economic theory indicates that efficiency will be achieved when all land parcels in the flood plain are allocated to their most productive uses and capital investment is carried to the optional level. When no public management of flood plain development exists, over-investment is likely to occur. When an insurance program is introduced in the form of actuarially premiums reflecting the expected average flood damage on each parcel of land, the market will allocate land to its most productive use and guide capital investment decision to the optimal level. A simple zoning approach would eliminate welfare losses due to overdevelopment in the flood plain, but it might prohibit some socially rational investments. Analysis of the impact of the Federal Flood Insurance Program in Logansport, Indiana, indicates residential property values in the flood plain were less than fully discounted for the existing flooding potential prior to introduction of the program. Overdevelopment had occurred and therefore, social welfare losses were being occurred. This implies there are benefits to be gained from more efficient allocation of resources in the flood plains.
W83-02477

6G. Ecologic Impact Of Water Development

LAND-USE AND MANAGEMENT PROBLEMS IN THE NILE DELTA,
Ministry of Irrigation, Cairo (Egypt). Research Inst. for Groundwater.
K. Hefny.
Nature and Resources, Vol 18, No 2, p 22-27, April/June, 1982. 4 Fig, 1 Tab.

Descriptors: *Environmental effects, *Coastal zone management, *Sedimentation, *Deltas, *Nile River Delta, Irrigation, Rivers, Sediment transport, Geomorphology, Ecological effects, Aquatic plants, Drainage, Aswam Dam, *Egypt.

The Nile River delta and its ecosystem have been affected by water control projects and urban development, especially within the last 100 years. The Aswan High Dam, constructed during the 1960's, has reduced the silt load to 1.5-4% of that formerly carried by the river. Unless a new equilibrium is reached, the delta will gradually recede. The estuarine ecosystem has been altered drastically by changes in the salinity regime and nutrient levels. Basin irrigation has given way to perennial irrigation, but drip or sprinkler irrigation could save an additional 30-50% of the water. Water hyacinth and other aquatic plants, which have flourished in the irrigation canals, influence biotic relationships, both positively (food sources) and negatively (disease-carriers). The large groundwater reservoir underlying the delta is of great economic importance, but present knowledge is insufficient for proper management. Several strips of the seacoast several kilometers wide have been removed by the sea during the last 200 years. The erosion process, especially in the softer western and eastern parts of the delta, is expected to increase with the reduction of sediment deposition. Research and monitoring of the river and delta must be interdisciplinary to provide reliable information for managing water resources and protecting the coastline. (Cassar-FRC)
W83-02462

PREDICTION OF EFFECTS OF DAILY FLOW FLUCTUATIONS ON STREAM BIOTA,
Michigan Univ., Ann Arbor. School of Natural Resources.
F. F. Hooper, and D. R. Ottey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-190454, Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research Completion Report, Michigan State Univ., East Lansing, December 1982. 46 p, 4 Fig, 12 Tab, 76 Ref. OWRT A-113-MICH(1), 14-34-0001-1124.

Descriptors: *In-stream flow, *Benthos, *Caddisflies, *Mayflies, Micro-distribution, Floods, Regulated flows, *Michigan, Streams, Trout, Species diversity, Hydroelectric power.

The short-term effects of regulated daily discharges on benthos communities were examined in a small Michigan trout stream. Flow regulation designs simulated fluctuations produced by storage and release for hydroelectric generation, as well as different constant daily stream diversions. Impacts on the dynamics of micro-distribution, species diversity, and behavior were evaluated on stable artificial substrates. Invertebrate drift rates were measured at different discharges during light and dark periods. The caddisfly G. nigrior became less active and oriented downstream when exposed to high discharge, and underwent movements to protected substrate faces. On exposed surfaces, low daytime discharge resulted in accentuation of the control pattern of micro-distribution changes, while high discharge during days produced the inverse diel pattern. The mayfly Baetis vagans also changed micro-positioning in response to flow fluctuations, but total density changes generally were more pronounced. Light period drift rates were low and weakly related to discharge for many species, while dark period drift was more strongly influenced by flow. Low to high discharge fluctuation impacts on densities were comparable to losses during a minor natural flood, and species most susceptible to flood impacts suffered greatest estimated losses following fluctuations to high flows. There was evidence for increased species diversity during low discharges.
W83-02480

THE CREST DISPUTE: A MEDIATION SUCCESS,
Institute for Environmental Mediation, Seattle, WA.
For primary bibliographic entry see Field 6D.
W83-02532

EFFECTS OF IMPOUNDMENT OF DESAULNIERS RESERVOIR (JAMES BAY TERRITORY) ON ZOOPLANKTON IN A RIVER AND A STRING BOG. (EFFETS DE LA MISE EN EAU DU RESERVOIR DESAULNIERS (TERRITOIRE DE LA BAIE DE JAMES) SUR LE ZOOPLANCTON D'UNE RIVIERE ET D'UNE TOURBIERE RETICULEE),
Montreal Univ. (Quebec). Dept. of Biological Sciences.
B. Pinel-Alloul, E. Magnin, and G. Codin-Blumer.
Hydrobiologia, Vol 86, No 3, p 271-296, 1982. 12 Fig, 6 Tab, 52 Ref.

Descriptors: *Zooplankton, *Population dynamics, *Reservoirs, Cladocera, Biomass, Rotifera, Copepods, Bogs, Ecological effects, Rivers, Desaulniers River, James Bay territory, Reservoir stages, Canada.

Results are presented of a three year study on the effects of impounding a river on the zooplankton communities in that river. Forty zooplankton samples were collected from the Desaulniers River and from a string bog in 1976 before impoundment. Sampling was also conducted in 1977 (331 samples) and 1978 (153 samples) during and after impoundment. The population dynamics of zooplankton show different patterns in 1977 and 1978. The main impacts of impoundment on the river and the bog communities were increases in the number of species of Rotifera and the increase of the diversity indices based on numbers and biomass. These changes are observed at each sampling station. The total biomass increases in lotic stations but decreases in the string bog because the density and the biomass of Cladocera increased in the river but dropped in the bog. Results are compared to those obtained in natural lakes and bogs of the same area and to those published in other studies. (Baker-FRC)
W83-02604

INTERACTION OF LARGE HYDRAULIC ENGINEERING SYSTEMS WITH THE ENVIRONMENT,
S. L. Vendrov.
Hydrotechnical Construction, No 2, p 175-181, February, 1980. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 2, p 40-44, February, 1980.

Descriptors: *Water resources development, *Environmental effects, *Hydroelectric plants, Reservoirs, Economic development, Hydraulic engineering, Water management, Planning, Forecasting, *USSR.

The history and present status of environmental protection during water resources development projects in the USSR are discussed. Present Policies are based on party directives, the USSR constitution, and the constitution of union republics. Decisions affecting the environment are made throughout an entire project, from predesign through final construction. In several projects design plans were revised or projects dropped as changes in the natural and economic setting and goals for conservation changed. In general, the higher the level of development and installed power per worker, the more stringent the environmental protection requirements. As development increases, environment protection becomes increasingly important. No land is so unimportant that it can be turned into a wasteland. There are territorial differences in policy, such as use of pipelines and underground structures rather than open channels for water transport in heavily populated and industrialized regions. The preliminary forecast of environmental impact uses file and literature sources and takes about a year in the predesign stage. The main forecast involves field, laboratory, mathematical, modeling, and theoretical investigations over several years. These findings are successively refined as necessary. It is emphasized that forecasts must be individualized to the project. A forecast should include viewpoints of a variety of specialists and organizations, the effects of a project (such as interbasin transfer) on all the geographic zones, substantiation that adverse effects will not be irreversible, and unconditional provision of medical-sanitary aspects of water. (Cassar-FRC)
W83-02606

ECOLOGICAL FOUNDATIONS OF MEASURES TO PROTECT THE HYDROSPHERE AGAINST MAN-MADE POLLUTION,

Institute of Biology of the Southern Seas, Sevastopol (USSR).
G. G. Polikarpov.
Hydrobiological Journal, Vol 17, No 6, p 1-8, 1981. 4 Fig, 23 Ref.

Descriptors: *Environmental effects, Water pollution effects, Pollutant identification, Monitoring, Model studies, Forecasting, Air pollution.

The ecological study of the measures for protection of the hydrosphere against man-made pollution consists of the following essential elements: analysis of aspects of man-induced contamination and alteration of the environment to achieve an understanding of the effect of such alterations on the ecology of salt- and freshwater environments; analysis of mechanisms of direct and indirect effect of combinations of man-made pollutants on aquatic ecosystems; the development of models and forecasts of ecological changes in seas, lakes, and streams as a result of human activity; ecological monitoring of the state and changes in hydrospheric zones under stress of man-made pollutants; and a description of specific ecological responses in particular regions and under specific man-made pollution conditions, with development of recommendations and measures for decreasing that pollution in aquatic ecosystems. Each of these subjects falls under one of three general headings: overall problems, including the concept of capacity of environments to deal with contaminants; central problems of ecological monitoring; and the principles of science of freshwater protection from contaminants. (Baker-FRC)
W83-02626

ENVIRONMENTAL CONSIDERATIONS OF THE DRAKENSBERG PUMPED STORAGE SCHEME,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
C. P. R. Roberts, and J. J. Erasmus.
Civil Engineer in South Africa, Vol 24, No 8, p 361-363, 365, 368-371, 373, 455, August, 1982. 19 Fig, 11 Ref.

Descriptors: *Pumped storage, *Environmental engineering, Drakensberg Pumped Storage Scheme, *South Africa, Reservoirs, Landscaping, Construction, Aesthetics, Vegetation, Dam construction, Kilburn Dam, Earth dams.

Planning of the Drakensberg, South Africa, pumped storage scheme involved environmental considerations from the earliest stages. A committee representing public and private sectors prepared an environmental impact assessment for the construction area, a place of natural scenic beauty. Recommendations for minimizing environmental damage included afforestation of acquired farmland, construction of temporary roads on the routes of permanent roads and in designated locations, preservation of indigenous vegetation, replanting with only indigenous species, location of borrow areas and spoil material in regions to be submerged, construction of power lines and towers in non-straight lines and in inconspicuous colors, a visitor's center, excavation of fossil or archeological sites prior to destruction, and consideration of aesthetics in landscape and building design. (Cassar-FRC)
W83-02664

COME HELL AND HIGH WATER: MT. ST. HELENS AND THE FEDERAL RESPONSE ON THE LOWER COWLITZ RIVER,
Central Washington Univ., Ellensburg. Dept. of History.
For primary bibliographic entry see Field 4A.
W83-02724

EVALUATING THE INFLUENCE OF GEOCHEMICAL ORIGIN AND DROUGHT ON AQUATIC BIOTA OF THE KNOWN GEOTHERMAL RESOURCE AREA (KGRA) OF CALIFORNIA,
California Univ., Berkeley. Div. of Entomology and Parasitology.
V. H. Resh, G. A. Lamberti, E. P. McElravy, and J. R. Wood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-191809, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, California Water Resources Center, Univ. of California, Davis, March 1983. 124 p, 10 Fig, 9 Tab, 62 Ref. OWRT B-200-CAL(1).

Descriptors: *Geothermal studies, *Biological sampling, Sampling, *Data Collections, Aquatic life, Benthic environment, Benthos, *California, *The Geysers KGRA, Biota, Energy development, Drought.

From 1976-1983, a series of studies was undertaken at the Geysers KGRA in Sonoma and Lake Counties, California to evaluate the effects of geothermal energy development on aquatic biota at The Geysers. A major objective throughout the eight years of the research project has been to develop quantitative methods to analyze and monitor benthic communities. This report summarizes the methods used and presents examples of the data such approaches have produced. Each report on a sampling approach contains: (1) a summary of the advantages and disadvantages of the device; (2) an illustration of the device; (3) a description of its use either at The Geysers or in pilot studies to test the appropriateness of its use at The Geysers; and (4) a sample data set. (Snyder-California)
W83-02725

VALUATION OF INTANGIBLES: THE CASE OF WATER QUALITY,
Massachusetts Univ., Amherst. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6B.
W83-02732

THE SEPARATION OF THERMAL AND CHEMICAL EFFECTS IN EVALUATING GEOTHERMAL INFLUENCES ON AQUATIC BIOTA,
California Univ., Berkeley. Div. of Entomology and Parasitology.
For primary bibliographic entry see Field 5C.
W83-02738

HYDROELECTRIC POWER UTILIZATION AND ENVIRONMENTAL PROTECTION (WASSERKRAFTNUTZUNG UND UMWELTSCHUTZ),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
D. Vischer.
Wasser, Energie, Luft, Vol 74, No 3, p 33-40, March, 1982. 12 Fig, 14 Ref. English summary.

Descriptors: *Hydroelectric power, *Environmental effects, *Ecosystems, *Hydrologic systems, *Human population, Climates, Geology, Economic aspects, *Switzerland, Reservoirs, Animal populations, Wildlife habitats, Plant populations, Water resources development, Safety.

The environmental impacts of hydroelectric power plants in alpine and prealpine regions are reviewed, focusing on specific Swiss examples. Impacts on physical systems include influences on the water cycle, on the atmosphere, and on the crust of the earth. The quantity of surface waters is influenced differently by plants with dams and those using running water, and underwater quantity is impacted by reservoir construction. Reservoirs act as settling basins for sediments and suspended solids, thereby influencing water quality. Heat stored in reservoirs and the associated evaporation can cause climatic changes, though these are minor in alpine regions. The saturation of valley sides flooded by reservoirs can reduce their stability, resulting in landslides or even minor earthquakes (as occurred at the Contra reservoir near Locarno). Impacts on biological systems involve the terrestrial and aquatic systems. While new reservoir construction annihilates animals and plants, reservoirs with level banks and constant water levels sometimes foster a rich vegetation (those with fluctuating water levels often form a desert-like strip along their banks). The initial filling of a reservoir results in a rapid enrichment of the water with nutrients, impacting on the food chain of the reservoir's population. In reservoirs too high above sealevel for a rich animal and plant life or in which the land was cleared before flooding, pollutants in the inflowing water exert a larger influence, and the reservoirs act as sand filters and purification basins. (Gish-FRC)
W83-02788

7. RESOURCES DATA

7A. Network Design

REMOTE SENSING DETERMINATION OF HYDROGRAPH RECESSION CHARACTERISTICS,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W83-02487

7B. Data Acquisition

A MICROPROCESSOR BASED WATER LEVEL RECORDER AND SAMPLER CONTROLLER,
Anne Arundel County Dept. of Public Works, Glen Burnie, MD. Utility Bureau.
R. L. Kort, A. T. Johnson, J. E. Ayars, and A. D. Schlosser.
Transactions of the ASAE, Vol 25, No 5, p 1282-1283, 1289, September/October, 1982. 2 Fig, 2 Ref.

Descriptors: *Data acquisition, *Data storage and retrieval, *Samplers, Water level, Water sampling, Microprocessors, Computers.

Acquisition and analysis of hydrologic data using current techniques is a time consuming and expensive process which demands better data collection and reduction procedures. Very low power consumption levels, wide operating temperature range, and good noise immunity make the 12-bit CMOS microprocessor ideal for portable, self-contained instrumentation. The collection unit is comprised of a microcomputer including non-volatile memory boards, support hardware, a shaft angle encoder, a float operated level sensor, a cabinet to house the electronics, and a base to hold the cabinet and encoder. The data transfer unit consists of a second Intercept Jr. Microcomputer, non-volatile memory boards, a serial Input/Output module, a terminal, and a telephone modem computer link. (Baker-FRC)
W83-02457

AUTOMATIC TENSIOMETER SCANNER FOR RAPID MEASUREMENTS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. B. Bottcher, and L. W. Miller.
Transactions of the ASAE, Vol 25, No 5, p 1338-1342, September/October, 1982. 6 Fig, 12 Ref.

Descriptors: *Tensiometers, *Measuring instruments, *Electronic equipment, *Soil moisture, Moisture availability, Soil water, Irrigation practices.

An automatic tensiometer scanning device was designed and constructed to read and record eighty individual tensiometers at a maximum frequency of once a minute. Scanning photocells were used to detect mercury levels in manometer-type tensiometers. The drive mechanism, photocells, and light sources are controlled or sensed by a battery powered microprocessor through an interface box. The data are stored on a magnetic tape and/or printed on paper. Accuracy is limited by the response time of the tensiometer itself, but differences in the mercury level can be detected to within 0.08 cm of mercury. Reliability of the prototype scanners has been excellent. The cost per tensiometer read for the described system can be lower than for other currently available multi-tensiometer rapid measurement systems. (Baker-FRC)
W83-02458

MEASUREMENT AND MODELING OF MICROWAVE EMISSION FROM FORESTED SNOWFIELDS IN MICHIGAN,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2C.
W83-02774

7C. Evaluation, Processing and Publication

QUANTIFYING SOURCE AREAS THROUGH LAND SURFACE CURVATURE AND SHAPE,
Massey Univ., Palmerston North (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W83-02702

WEEKLY WATER USE ESTIMATES BY CROPS AND NATURAL VEGETATION IN INDIANA,
Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 2D.
W83-02739

DETECTION OF RAINFALL RATES UTILIZING SPACEBORNE MICROWAVE RADIOMETERS,
Environmental Research and Technology, Inc., Concord, MA.
For primary bibliographic entry see Field 2B.
W83-02798

8. ENGINEERING WORKS

8A. Structures

HYDRO-FRACTURING AT HELMS,
Pacific Gas and Electric Co., San Francisco, CA.
A. G. Strassburger.
International Water Power and Dam Construction, Vol 34, No 10, p 25-28, October, 1982. 2 Fig, 4 Ref.

Descriptors: *Hydroelectric plants, *Pumped storage, *Rock excavation, Hydraulic machinery, Pump turbines, Turbines, Construction, Helms Project, *California, Underground powerplants, Tunnels, Conduits, Hydrofracturing, Pacific Gas and Electric Company, Powerplants, Tunnel linings, Linings.

Several unusual features were incorporated into the Helms project (Pacific Gas and Electric Company of San Francisco), located in the Central Sierra Nevada Mountains 85 km northeast of Fresno. Topographic, geologic, environmental, and esthetic considerations dictated the alignment of conduits and the locations of other equipment, mostly underground. Surrounding rock and the reinforced concrete tunnel lining will be deliberately hydro-fractured by the hydrostatic loads, which will be excessive because of long water conduits, deep powerhouse submergence, need for 2 surge tanks, and a desire for rapid load response and turnaround. A conservatively designed drainage system will protect the other underground facilities from high hydrostatic pressures. For environmental reasons no access road was built at the top of the surge shaft and workers were not housed on site. The penstock shaft, inclined at 55 degrees, proved far more difficult to construct than anticipated. Concrete was delivered at extremely high heads by pipe placing methods. A unique feature of the generator-motors is the cooling system. A conventional air ventilation system cools all components but the stator coils, which are cooled by very pure water. Construction delays were caused by extremely adverse winter weather, geological conditions, and the remoteness of the site. (Cassar-FRC)
W83-02539

THE DESIGN OF DRAKENSBERG,
Electricity Supply Commission, Johannesburg (South Africa).
W. Z. Pyzikowski.
International Water Power and Dam Construction, Vol 34, No 10, p 33-36, October, 1982. 2 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Pumped storage, *Reservoir operation, Reservoirs, Interbasin transfers, Water transfer, Powerplants, Drakensberg Plant, *South Africa, Driekloof Reservoir, Kilburn Reservoir, Sterkfontein Reservoir, Tunnels, Conduits, Underground powerplants.

The Drakensburg hydroelectric plant in South Africa operates two reservoirs, Driekloof and Kilburn, 4 km apart and with 446 m difference in head. It functions as a pumped storage plant and in the interbasin transfer of water between the Tugela and Vaal River basins. A unique feature is the creation of Driekloof Reservoir within a cove of the larger Sterkfontein Reservoir. The Driekloof dam spillway, which is submerged for 12% of the time, provides water for operating the scheme on a weekly cycle when the larger reservoir level is too low. The lower Kilburn dam operates on a weekly cycle with a load factor of 30% in the generating mode. An underground waterway system consists of tunnels, shafts, and penstocks, which are described in detail. There are three main underground caverns: machine hall, valve hall, and transformer hall. (Cassar-FRC)
W83-02541

CZECHOSLOVAKIA'S LARGEST PUMPED-STORAGE PLANT,
Hydroconsult, Bratislava (Czechoslovakia).
J. Motlik.
International Water Power and Dam Construction, Vol 34, No 10, p 36-39, October, 1982. 5 Fig, 3 Ref.

Descriptors: *Pumped storage, *Hydroelectric plants, Cierny Vah, *Czechoslovakia, Reservoir operation, Powerplants, Tunnels, Dam construction, Seepage control, Turbines, Pump turbines, Hydraulic machinery, Penstocks.

The Cierny Vah pumped storage plant, scheduled for completion in 1983, is the largest of its type in Czechoslovakia. It has the capacity to produce 1285 GWh per year. Main components are the lower reservoir with a mean annual inflow of 4.25 cu m per sec, the upper reservoir with no natural inflow, penstocks, and surface powerplant. Both reservoirs have a 3.7 million cu m storage capacity. A particular problem was the permeability of the clay-contaminated local dolomites and limestones. The upstream face of the upper reservoir was sealed with asphalt, and a system was created for seepage monitoring. At the dam foundation, hollows were discovered beneath the design foundation level; these had to be filled before sealing. Installed capacity of the powerhouse is 665 MW. Daily generation lasts for 5.53 hours, and pumps are operated for 8 hours, On a yearly basis turbines are used for 2018 hours and pumps for 2920 hours. Turbine and pump rates of flow are 30 and 22 cu m per sec, respectively for each of the 6 units. (Cassar-FRC)
W83-02542

BUILDING A HYDRO STATION IN A NARROW GORGE,
I. G. K. Soos.
International Water Power and Dam Construction, Vol 34, No 6, p 20-26, June, 1982. 14 Fig, 1 Tab.

Descriptors: *Design criteria, *Dam construction, *Dam design, *Hydroelectric power, *Brazil, *Canyons, Construction costs, Dam foundations, Reservoirs, Electric power production, Electrical equipment, Hydraulic turbines, Sao Francisco River.

The unusual design and construction problems of the Xingo hydroelectric development on the Sao Francisco River in northeast Brazil are described. The dam is to be built in a narrow gorge with an average slope of 120 degrees. The high river flow of 2060 cu m/sec means that filling, if uncontrolled, would take 11.5 days. The reservoir is expected to have little ecological impact and negligible siltation. The river bed itself will serve as a plunge-pool, and the filling of the reservoir will have to be controlled with large capacity outlets. An exploration shaft will determine the performance of the foundation rock, gorge sediments and fault zone. A building will be erected with an overhead travelling crane and railways and aerial cableways for placing prefabricated elements in the gorge. Construction will be carried out without diversions or cofferdams. When a three-stage river closing is complete, the reservoir will be filled and plans for operation of the ten 400 MW generators will commence. Each generator is coupled to 545 b.h.p. Francis turbines. The elimination of diversion tunnels and cofferdams will save construction time and cut costs. (Geiger-FRC)
W83-02543

SURGE CHAMBER DESIGN FOR JUKLA,
Geoteam A/S, Oslo (Norway).
For primary bibliographic entry see Field 8E.
W83-02572

OVERFLOW ROAD CROSSING ACROSS THE DNESTR RIVER AT THE CONSTRUCTION SITE OF THE DNESTR HYDROSTATION,
B. D. Shmul'son.
Hydrotechnical Construction, No 11, p 1115-1119, November, 1980. 3 Fig, 2 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 11, p 9-12, November, 1980.

Descriptors: *Bridges, *Construction, *Overflow, Hydroelectric plants, Dnestr River, *USSR, Dam construction, Floods.

An overflow bridge was constructed across the Dnestr River, USSR, to provide passage for construction vehicles during building of the hydrostation there. The low-cost crossing was constructed in conjunction with the cofferdams over a period of several months. The crossing consists of 5 reinforced concrete pipes (cross section 5.5 x 6.0 m) and a rock embankment damming the river channel. The crest of the embankment serves as the roadway. After completion in November 1977, the bridge survived several floods, many containing large ice floes. There were eight overflow floods in 1978 and three severe winter floods with large amounts of ice in 1979. Damage to the bridge was not significant. Adjustments to the design prevented further undesirable erosion. (Cassar-FRC)
W83-02594

MULTISTAGE WHIRLPOOL SHAFT SPILLWAYS,
S. M. Slisskii, E. B. Kuznetsov, and T. Kh. Akhmedov.
Hydrotechnical Construction, No 9, p 892-895, September, 1980. 3 Fig, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, 10-12, September, 1980.

Descriptors: *Spillways, *Tunnels, *Flow pattern, Reservoirs, Conduits, Water flow, Spiral spillway, Tangential spillway, Design criteria, Dam design, *USSR, Meodeo Dam.

A design ensuring impactless entry of flow from horizontal or inclined tunnels into a shaft was investigated. The tangential feed arrangement (tunnel connected to the shaft so that the external tunnel wall is tangent to the shaft wall) was tried at the Medeo mudflow protection dam in the USSR. A scale model was used to verify the tangential design and to investigate a spillway alternative with a spiral chamber. Discharge capacity, length of the stretch in which rotational motion is maintained, and the angle of twist of the flow in the initial section were almost equal for tangential feed and spiral chambers. (Cassar-FRC)
W83-02597

INSTRUMENTING AUSTRALIA'S CETHANA DAM,
Tasmania Hydro-Electric Commission, Hobart (Australia).
M. D. Fitzpatrick, and R. H. W. Barnett.

International Water Power and Dam Construction, Vol 34, No 11, p 26-30, 1982. 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Dam construction, *Dam stability, *Dam foundations, *Monitoring, *Concrete dams, *Rock mechanics, *Stress, *Deflection, Deformation, Pressure measuring instruments, Dam design, Rockfill dams, Leakage, Strain, Dams, Measuring instruments, Cethana dam, *Australia.

A monitoring system was installed at the concrete-faced Cethana dam in Australia to provide measurement of vertical settlement within the embankment, deflection at crest level and on the downstream face, deflection in the vertical and slope directions, and normal deflection of the membrane and the plinth, strain and temperature in the membrane, no-stress strain and temperature in the concrete blocks resting on the membrane, and leakage at the downstream toe. The general arrangement of the system is diagrammed, and specific aspects of the monitoring scheme such as settlement cells, crest targets, downstream face targets, anchored membrane deflection wires, installation of inclinometers, perimetric joint meters, and leakage weirs are described. Since the dam was performed satisfactorily for eleven years, monitoring of dam functions will be reduced to five yearly intervals. Between 1973 and 1980, settlement and deflection rates were stabilized at about 4 and 3 mm per year, respectively. Increased deflection close to the crest is attributed to reduced confinement near the downstream face. Settlement measurement have been affected by flushing of organic matter from the hydrostatic cells. No real changes in joint movements have occurred since the first year. Strain and stress measurements combined with creep response and inclinometer and survey data indicate overall structural stability. Leakage has remained at 10 liters/sec for the past 6 years. As a result of experience with the Cethana dam monitoring system, the Hydro-Electric Commission of Tasmania has been able to improve features of the downstream face targets, anchored face wires, perimetric joint measurements, inclinometer pipes and strain meters for future dam monitoring systems. Several other dams have benefited from dam monitoring knowledge gained at Cethana dam. (Geiger-FRC)
W83-02603

LONG-TERM MONITORING OF EMBANKMENT DAMS IN BRITAIN,
For primary bibliographic entry see Field 8D.
W83-02628

THE CONSTRUCTION OF THE TUGELA-VAAL PROJECT DAMS,
Davies and Loubser Ltd. (South Africa).
A. G. Davies.
Civil Engineer in South Africa, Vol 24, No 8, p 385-387, 389, August, 1982. 5 Fig, 3 Ref.

Descriptors: *Dam construction, *Pumped storage, Reservoirs, Construction, Woodstock Dam, Sterkfontein Dam, Driekloof, Kilburn Dam, Tugela River, Vaal River, Earth dams, Rockfill dams, Spillways, Drakensberg Pumped Storage Scheme, *South Africa.

Construction of the Tugela-Vaal project dams, part of the Drakensberg Pumped Storage Scheme in South Africa, is described. Woodstock, 49 m high, was constructed within 1 year with materials borrowed from the basin. The impervious core is well-decomposed dolerite. Curtain grouting was difficult. Kilburn Dam, 51 m high, is in an environmentally sensitve section. Driekloof Dam, subject to continued cycles of very rapid drawdown and filling, was made of soft sandstone. Sterkfontein Dam has a small catchment relative to the basin size, so no spillway was constructed. During the second stage, this dam is being raised from the first stage of 69 m to 93 m. (Cassar-FRC)
W83-02643

THE DAMS OF THE TUGELA-VAAL PROJECT,
Department of Water Affairs, Forestry and Environmental Conservation, Pretoria (South Africa).
H. F. W. K. Elges.
Civil Engineering in South Africa, Vol 24, No 8, p 375-377, 379-381, 383-384, August, 1982. 12 Fig, 13 Ref.

Descriptors: *Pumped storage, *Dam construction, Drakensberg Pumped Storage Scheme, *South Africa, Reservoirs, Construction, Tugela River, Vaal River, Earth dams, Spillways, Kilburn Dam, Driekloof Dam, Sterkfontein Dam, Woodstock Dam.

Some interesting engineering features of the four-dam Drakensburg Pumped Storage Scheme, South Africa, are described. The Driekloof Dam, located within the Sterkfontein Basin, was built with soft sandstone fill. A baffled apron spillway was placed centrally over the embankment. The Kilburn Dam was built with material from the dam basin; the upstream dam face is rather flat. The Woodstock Dam was also constructed with local materials and a flat upstream slope. Its spillway is an uncontrolled curved ogee overflow, chute, and energy dissipator. The Sterkfontein Dam, largest in South Africa when finished, was made of local stones of varying composition, giving rise to a rather flat upstream slope. (Cassar-FRC)
W83-02648

BOUNDARY METHODS IN WATER RESOURCES,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Investigacion en Matematicas Aplicadas y en Sistemas.
I. Herrera.
Advances in Water Resources, Vol 5, No 3, p 130-135, September, 1982. 2 Fig, 33 Ref.

Descriptors: Water resources, *Boundary methods, Mathematical equations, *Boundary conditions.

A brief review of boundary methods is presented, placing emphasis on alternatives to boundary integral equations. Different theoretical questions required to give a firm foundation to these procedures are discussed, and extensions to non-linear problems are explained. Examples of application to fluid problems are included. An abstract framework which can be used to make the subject more systematic is briefly described. This can be interpreted in terms of Green's formula and presented in a form which is suitable for application to formally symmetric operators, although it has recently been extended to general non-symmetric operators. One of the applications of this framework is the formulation of variational principles. Problems formulated in discontinuous fields with prescribed jump conditions such as those that were surveyed by Nemat-Nasser constitute a general application of the theory. Another example is problems which are subjected to continuation type restrictions, that is, problems formulated in a region subjected to the restriction that the solutions can be continued smoothly into solutions of given differential equations in a neighboring region. (Baker-FRC)
W83-02655

CONSTRUCTION OF THE MAIN CIVIL WORKS OF THE DRAKENSBERG PUMPED STORAGE SCHEME,
P. A. C. Hallier, P. B. Weehuizen, and G. W. Holl.
Civil Engineer in South Africa, Vol 24, No 8, p 421, 423-425, 427-429, 431-433, August, 1982. 12 Fig, 2 Tab, 6 Ref.

Descriptors: *Rock excavation, *Underground structures, *Tunnels, Civil engineering, Drakensberg Pumped Storage Scheme, *South Africa, Excavation, Powerplants, Construction, Pumped storage, Concrete technology, Grouting.

Civil works for the Drakensberg Pumped Storage Scheme, South Africa, involved excavation of 510,000 cu m of rock and installation of concrete, steel, and rock bolts. This phase of the project, lasting from 1977 to 1981, required excavation, support, lining, and grouting large excavations in rock formations of poorly cohesive nature. The presence of thin layers of carboniferous materials required application of Fiery Mines regulations. Types of work were circular shafts (1.83-3 m for ventilation and 19 m for downstream surge chambers), surge/pressure shafts, smaller shafts, tunnels (3 x 3 m to 7.75 x 8.5 m), halls (machine, transformer, and valve) and grouting. For each type of construction, the methods, breaking, mucking, and lining and support are described. Grouting was especially complicate and exacting. Use of the interface or pre-stress grouting method was unique in this country. (Cassar-FRC)
W83-02665

THE STERKFONTEIN DAM OUTLET WORKS,
A. W. Sykes, and W. C. S. Legge.
Civil Engineer in South Africa, Vol 24, No 8, p 391-393, 398, August, 1982. 4 Fig, 7 Ref.

Descriptors: *Outlets, *Stilling basins, Dam construction, Sterkfontein Dam, Drackensberg Pumped Storage Scheme, Tunnels, Construction, Pumped storage, Cavitation, Hydraulic gates, Gates, *South Africa.

The outlet works of the Sterkfontein Dam (Drakensberg Pumped Storage Scheme, South Africa) include a pair of leaf or slab gates 1.5 m x 4 m, one of the largest of their type in the world. A 430 m long pressure tunnel leads to the gates, directly under the dam crest. Small discharges are handled by a 600 m gate valve which bypasses the main gates to prevent cavitation erosion. Downstream of the gates, the flow is free at velocities up to 30 m per sec. The tunnel ends in a transition zone and stilling basin, which discharges into a 30 m wide riprap-lined canal. A model was built to study performance of the design. It showed that the stilling basin needed certain modifications--a hump on the transition zone floor, guide vanes to divert more flow to the sides, a round step (radius = height) at the drop, and a wave suppressor at the basin entrance. (Cassar-FRC)
W83-02666

THE DRAKENSBERG PUMPED STORAGE SCHEME DESCRIPTION OF SCHEME AND PRINCIPAL DATA,
Electricity Supply Commission, Johannesburg (South Africa).
W. Z. Pyzikowski.
Civil Engineer in South Africa, Vol 24, No 8, p 353-356-357, 359, August, 1982. 3 Fig, 2 Tab.

Descriptors: *Hydroelectric powerplants, *Design criteria, *Pumped storage, Reservoirs, Planning, Interbasin transfers, Decision making, Management, Dams, Water supply, *South Africa, Drakensberg Project.

The Drakensberg Pumped Storage Scheme is described as a whole, including its functions, main features of the upper and lower reservoirs, the geometry and dimensions of the waterways, arrangement of underground caverns as well as the principal hydro-mechanical data of the scheme. Certain aspects of the philosophy of the design of the scheme are also included. The scheme was designed to operate as a pumped storage facility capable of generating normally 1,000 MW during the peak demand hours and up to 1,080 MW under high head conditions, and utilizing relatively cheap surplus power available during the off-peak periods for pumping. The scheme was also to effect the inter-catchment transfer of water between the Tugela River basin and the Vaal River basin. The most unusual feature of the scheme is the very large volume of the upper and lower reservoirs, which can support operation of the scheme, in generating mode, with a weekly load factor of up to 30%. This means that during the scheme's weekly operating cycle the full output of 1,000 MW can be generated for up to 10 hours per day during the five working days, Monday-Friday. Very few pumped storage schemes in the world generate longer than two to three hours daily without pumping and many of them have been designed to generate for less than one hour at a time. (Baker-FRC)
W83-02671

TECHNOLOGY--WHAT IS IT FOR. TWO EXAMPLES FROM THE MORE THAN 2,000-YEAR HISTORY OF HYDRAULIC ENGINEER-

ING IN CHINA (TECHNIK WOZU. ZWEI BEISPIELE AUS DER UBER 2000JAHRIGEN GESCHICHTE DES WASSERBAUES IN CHINA),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
T. Dracos.
Wasser, Energie, Luft, Vol 73, No 1/2, p 11-14, January/February, 1981. 7 Fig, 5 Ref. English Summary.

Descriptors: *Hydraulic engineering, Dams, *Irrigation, *Flood control, *Hydroelectric plants, *China, Earth dams, Gravity dams, Overflow channels, Yellow River, Minjian River, Reservoirs, Silting, River basin development, Flood protection, History.

The question 'Technology: what is it for, where is it going' is answered using the examples of two Chinese water projects, the Dujiangyan irrigation project and the multipurpose facility at Sanmenxia. The Dujiangyan project was constructed from 256 to 252 B.C., while the Sanmenxia plant was built during the 1950s and '60s A.D. The irrigation project, which is still serving its original purpose successfully (after expansion, it irrigates 570,000 hectares), consists of three parts: an earth dam that separates the Minjian river into inner and outer channels; an approximately 20-m-wide entrance, cut into the rock of the river bank, to the irrigation network; and an overflow channel. The 'outer' channel, which is actually situated on the inner part of a channel, flowing parallel on the other side of the dam, directs water into the irrigation ditches. Superflous water from the inner channel is returned to the river below the dam. The project also screens out most of the rocks and debris carried by the river from the irrigation network. The Sanmenxia plant (for flood control, irrigation, and energy production) is situated at the lower end of the midsection of the Yellow River and consists of a 702-m-long gravity masonry dam and a 206-m-long earth dam. It was designed to solve the problems of the river (1,500 dam breaks in the last 2,000 yr and 9 changes in the course of the lower river). The filling of the reservoir began in 1960. By 1964, the reservoir was already so heavily silted that the danger of upstream flooding was extremely high, so that construction changes had to be instituted. The limits of technology today must be recognized. (Gish-FRC)
W83-02760

CUBELLES THERMAL POWER PLANT-A NEW SOLUTION FOR THE INTAKE AND DISCHARGE OF COOLING WATER (CENTRA TERMICA DE CUBELLES-UNA NUEVA SOLUCION PARA LA TOMA Y DESCARGA DE AGUA DE REFRIGERACION),
Madrid Univ. (Spain).
P. S. Bores.
Progress in Water Technology, Vol 12, No 1, p 419-426, 1980. 5 Fig, 1 Tab, 5 Ref. English summary.

Descriptors: *Intakes, *Powerplants, *Construction, *Cooling water, Coastal waters, Recreation, Sand traps, Marina, Boating, Esthetics, Waves.

By converting a primary sand trap into a beach and a secondary sand trap into a marina, the intake for a million kilowatt fuel power plant in shallow waters off the Catalonian coast was transformed into a multi-purpose complex. The complete breakwater system is longer than a mile. In efforts to preserve the sea panorama, the crest of the breakwater was made only four feet higher than the mean sea level and was provided with a special energy dissipator. Tests were made on the new breakwater in early 1977 using irregular waves. These tests show complete efficiency with a total dissipation of energy, even for the highest waves permitted by the existent depth. Under extreme conditions when the mean sea level was higher than breakwater crest, the wave height on the sheltered side was less than two feet. It was estimated that the cost of the traditional intake at this particular site would be about 20 million dollars. The cost associated with the described solution has been around 5 million dollars, and it provides the added benefit of mooring berths being made available. (Baker-FRC)
W83-02795

8B. Hydraulics

SPILLWAY AERATION OF THE SAN ROQUE PROJECT,
Electroconsult, Milan (Italy).
L. Eccher, and A. Siegenthaler.
International Water Power and Dam Construction, Vol 34, No 9, p 37-40, September, 1982. 11 Fig.

Descriptors: *Spillways, *Aeration devices, *Cavitation, Erosion, San Roque, *Philippines, Dam Design, Hydraulic structures.

An aeration device for the open chute spillway at the San Roque project, Lower Agno River, Luzon, Philippines, was designed to prevent cavitation erosion of the spillway surface. Aeration devices produce a local pressure drop so that air is sucked into the flow to produce a compressible, impact-absorbing air-water mixture. The design was developed by testing in a 1:25 scale hydraulic model. Experiments showed that the depression in the air space under the nappe was strongly influenced by pressure losses along the air supply system. Air demand increased with increasing deflector height up to the limiting height of 0.75 m, above which the air demand remained constant. The air demand was a function of the flow velocity, not of the specific discharge. Three basic types of air slots were evaluated: groove, deflector, offset, and their combinations. The final design was a combination of an offset 0.75 m high and a deflector 0.5 m high. Spacing of the air slot was 50 m for mean flow velocities between 30 and 40 m per sec and 50 m for higher flow velocities. (Cassar-FRC)
W83-02540

MODELING OF WATERCOURSE CLOSURE (MODELISATION DE FERMETURE DES COURS D'EAU),
Sherbrooke Univ. (Quebec). Dept. of Civil Engineering.
K. Rohan.
Canadian Journal of Civil Engineering, Vol 9, No 2, p 156-169, June, 1982. 14 Fig, 15 Ref.

Descriptors: *Dams, *Construction, Design criteria, Dam collapse, Rockfill dams, Economic factors, Powerplants, Bottom roughness, Sediment transport.

In general a progressive lateral dumping of stones is considered for the construction of a rockfill dam in flowing water to accomplish river closure or repair a dam collapse. The aim of the present laboratory study was to determine an economical procedure for application to an actual powerplant structure and, if possible, to draw some conclusions of general validity. Scale modeling techniques of river parameters were well understood from the application of the laws of similarity of hydraulic flow and of bed load transport. It appeared to be more difficult to extrapolate the results from scale model studies of a river closure because of the uncertainty of extrapolation of some physical factors such as turbulence intensity, form coefficient of solid material, friction and inertia forces of dumped particles, and their stability in connection with bottom roughness. The same uncertainty also exists in the extrapolation of the duration of closure for a specific frequency of dumping. (Baker-FRC)
W83-02614

ESTIMATION OF THE SIZE AND ROUGHNESS OF SEDIMENTS IN HYDRAULIC CALCULATIONS,
A. B. Veksler, and V. M. Donenberg.
Hydrotechnical Construciton, No 9, p 924-930, September, 1980. 4 Fig, 3 Tab, 12 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 9, p 29-33, September, 1980.

Descriptors: *Particle size, *Sediment grading, *Soil physical properties, Screens, Roughness coefficient.

Sediment particle size may be described in several ways: nominal diameter (diameter of a sphere of the same volume as the particle), screening diameter, sedimentation diameter (diameter of a sphere of the same density and settling velocity as the investigated particle), standard sediment diameter (diameter of a 2.65 g per cu cm density sphere with the same settling velocity as the particle at 24C, and reduced diameter (diameter of a sphere whose volume is the mean statistical volume of particles of a given fraction). This paper reviews the discrepancies obtained when using screens of square or round holes and of woven or drilled construction. The authors suggest that the reduced diameter concept accounts for the differences in determination of particle size with screens of different hole shape, avoids conflicting recommendations, and increases the accuracy of roughness estimates. (Cassar-FRC)
W83-02622

SURGES OF FINITE HEIGHT,
Alberta Univ., Edmonton.
N. Rajaratnam.
International Water Power and Dam Construction, Vol 34, No 11, p 45-46, 1982. 3 Fig, 1 Ref.

Descriptors: *Surges, *Mathematical studies, Channel flow, Hydrodynamics, Waves, Wind tides, Storm surges, Hydraulics, Channels.

Diagrams are presented for predicting the characteristics of the surge produced by the reflection of a surge of finite height at a dead-end, and also for the surges produced by the collision between two surges of finite height. A surge is considered of finite height advancing with an absolute speed into a dead-end with a given depth in a rectangular channel. The surge is reflected at the dead-end and the height and speed of this reflected surge is determined. Similar diagrams can be developed to predict the behavior of surges of finite height at channel bifurcations and at steps. (Baker-FRC)
W83-02631

ANALYSIS OF A FINITE ELEMENT ALGORITHM FOR NUMERICAL PREDICTIONS IN WATER RESOURCES RESEARCH,
Tennessee Univ., Knoxville. Dept. of Engineering Science and Mechanics.
A. J. Baker, and M. O. Soliman.
Advances in Water Resources, Vol 5, No 3, p 149-155, September, 1982. 8 Fig, 12 Ref.

Descriptors: *Finite element analysis, *Algorithms, Water resources, Computers, Mathematical equations, Model studies, Hydrodynamics, *Fluid mechanics, Flow, *Prediction.

Pertinent results are highlighted on the assessment of accuracy, convergence and utility of a finite element algorithm for application to prediction of fluid dynamics phenomena in water resources applications. The findings illustrate the versatility of the developed algorithm for parametric studies in three-dimensional hydrodynamic transport. The diffusion and convection phenomena, inseparable in the physical simulation, can be individually analyzed using sufficiently high order accurate algorithm. The error produced using any consistent numerical algorithm is controllable with discretization refinement, but computer resource constraints place a severe limitation on the number of solution nodes for three dimensional flows. The examples cited employed 4913 node points, with the dependent variable, plus three velocity and three diffusion coefficients defined at each node, plus various geometry information. (Baker-FRC)
W83-02656

NUMERICAL CONVOLUTION FOR SOLUTION OF WAVE PROPAGATION PROBLEMS: FILTER SCHEME METHODS,
Texas A and M Univ., College Station. Dept. of Oceanography.
R. O. Reid, and D. R. Basco.

Journal of Hydraulic Research, Vol 20, No 4, p 329-349, 1982. 11 Fig, 1 Tab, 14 Ref.

Descriptors: *Wave propagation, Mathematical equations, *Numerical convolution, Hydraulics, Model studies, *Filters, Differential equations.

Filter scheme methods are numerical convolution techniques for the solution of partial differential equations and are fundamentally different from finite- difference or finite-element methods. The basic concept is that the output of any physical system can be calculated from the input if the response function is known for the system. The process becomes one of the convoluting the unknown variables over the space domain with a weighting function which is the Fourier transform of the response function. The method is studied for the simple one dimensional advection problem. The raw Fourier coefficients are found analytically but require smoothing by an appropriate taper function to produce a stable scheme for all wave numbers because of Gibb's effects near the Nyquist frequency. A constraining technique is also used near the very long wave scales to improve phase response of the filter. The method is shown to possess excellent numerical ability to accurately propagate very short waves associated with spiked or stepped functions. Comparisons with various common finite-difference schemes, under conditions of equal computation effort, demonstrate the filter scheme's superiority in this regard. The method can be extended to more general cases for which analytical solutions are not available. (Baker-FRC)
W83-02672

THIN SLENDER WATER JETS,
Adelaide Univ. (Australia). Dept. of Applied Mathematics.
M. S. Borgas, and E. O. Tuck.
Journal of Fluid Mechanics, Vol 119, p 379-391, 1982. 8 Fig, 9 Ref.

Descriptors: *Mathematical equations, *Jets, *Nozzles, *Velocity, *Flow, Physcial properties, Engineering, Mathematical studies, Fluid mechanics.

An analysis is provided for the free development of slender jets of water in which the cross-sections are of small thickness-to-width ratio. For simplicity, gravity is ignored, and it is assumed that the main jet is straight, lying close to the x-axis, and thinner in the z-direction than in the y-direction. The most important determinant of the jet's cross-section is the lateral velocity. Equations are presented for free jets. Examination of quadratic lateral velocity profiles gives further insight into the behavior of thin jets. Equations describing flow in thin slender nozzles are also presented. (Small-FRC)
W83-02677

FLUVIAL HYDRAULICS OF DELTAS AND ALLUVIAL FANS,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1282-1295, November, 1982. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Fluvial sediments, *Hydraulics, Flow characteristics, Fluid mechanics, Alluvial fans, Alluvial channels, Channels, Sedimentation, Erosion.

Delta formation and its associated stream channel hydraulics have been studied using data obtained in a large laboratory flume. The findings for deltas are generally applicable to alluvial fans. Delta or fan shape is directly related to the pattern of stream flow, its loci and mode of deposition. Under constant conditions, a stream channel on the delta usually has multiple branches. Compared with the single channel of the upstream reach, the branched channel has a similar energy gradient but a lower velocity and sediment load, indicating that deposition on the delta is not due to sudden reduction in energy gradient but due to the change in hydraulic geometry and its associated reductions in velocity and sediment load. Under steady conditions, mimimum stream power for a channel system is equivalent to the energy gradient or equal power expenditure per unit channel length along the channel. A change imposed on the channel system, such as a rising base level, a decreasing discharge, or an increasing sediment inflow, usually results in a lower energy gradient for the stream on the delta in relation to the upstream reach. Channel adjustment through widening or branching into distributary channels provides greater flow resistance and power expenditure for the delta stream, while its increased backwater effect decreases the power expenditure of the adjacent upstream reach. This process results in a more uniform power expenditure along the channel, while total power of the system is minimized. It was concluded that the stream channel changes reflect the stream's tendency to seek equal power expenditure along the channel. (Baker-FRC)
W83-02678

SALTATION IN WATER DYNAMICS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
P. J. Murphy, and H. Hooshiari.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY11, p 1251-1267, November, 1982. 10 Fig, 1 Tab, 17 Ref.

Descriptors: *Saltation, *Flow discharge, *Bed load, Sedimentation, Sediment load, Drag, Force, Channels, Channel flow, Dynamics, Hydrodynamics, Fluid mechanics.

An evaluation of the fluid forces exerted on a bed load particle is presented. The study used strobe photography to measure the kinematics of a sphere moving via saltation along the bed of an open channel flow. It was determined that an idealized gravel stream bed with a flow so strong that an exposed particle moves as bed load but not as suspended load can be described with a dynamic model that uses the particle's weight, the bed-impact force, and the fluid force due to the mean fluid flow. The force exerted on the particle by the moving fluid was composed of the effects of buoyance, added mass, and drag. The Magnus effect and the wall effect forces were not consistent with the observed data. The added mass force has two parts, one commonly used to describe added mass and horizontal force due to the motion of the particle across the mean fluid velocity gradient. This effect of the mean shear should be included in the equations of particle motion in sedimnt transport. Since the particle motion is determined by the flow, a given set of flow and bed conditions will permit trajectory sizes up to some maximum size. A reasonable distinction between particles deposited in a pit trap by the saltation and suspension processes might be whether their trajectory length is greater of less than the maximum saltation length. (Baker-FRC)
W83-02679

FLOW COMPUTATION USING EXTRAPOLATION PROCEDURES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W83-02695

LATERAL BED LOAD TRANSPORT ON SIDE SLOPES,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
S. Ikeda.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 11, p 1369-1373, 1982. 3 Fig, 8 Ref.

Descriptors: *Mathematical equations, *Bed load, *Sediment transport, Sedimentation, River beds, Bottom sediment, Canals, Model studies, Design criteria, Rivers, Banks.

Several difficulties are expected when estimating the lateral bed load transport rate. One is the problem of shear stress estimation on side slopes, and the other is the measurement of the lateral bed load transport rate. Immediate measurement of both is fairly difficult in open channel flows, and considerable error would be expected. To reduce these difficulties a laterally inclinable wind tunnel was used in the present study. After a steady sand movement with the airflow was achieved, laterally moving sand particles were collected. These data were supplemented with data on the variation of lateral bed profile with the time from a series of experiments on self-formed straight channels in sand beds. The lateral bed load transport rate increases in proportion to the tangent of the angle of inclination, and a duBoys' type bed load junction was proposed to express the experimental results. This formula should contribute to bank protection engineering, estimation of stable bed profile, and prediction of river migration rate. (Baker-FRC)
W83-02709

8C. Hydraulic Machinery

EXPERIENCE CURVES FOR FEASIBILITY STUDIES AND PLANNING OF MODERN LOW-HEAD HYDRO TURBINES,
Idaho Univ., Moscow. Dept. of Civil Engineering.
C. S. K. Kpordze, and C. C. Warnick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-186130, Price codes: A07 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, December 1982. 120 p, 42 Fig, 8 Tab, 23 Ref. OWRT A-077-IDA(1), 14-34-0001-2114.

Descriptors: Hydroelectric plants, *Turbines, Avial flow turbines, *Bulb turbines, *Tube turbines, *Low-head turbines, Design, Feasibility studies.

Results are presented of an extensive investigation of the characteristics of over two hundred low-head turbines maufactured all over the world that have been installed or are due to be installed in hydropower plants between 1953 and 1984. The research focused mainly on bulb turbines, with horizontal shaft arrangement, and tubular turbines with their shafts either horizontal or included at an angle to the horizontal. The characteristics of the above mentioned type of turbines are presented in the form of statistical diagrams and regression equations suitable for preliminary design and feasibility studies of low-head hydro projects. Nomographs have been developed for displaying the relationships between the various turbine characteristics and comparing the important dimensions and parameters of turbines which have found common application in the hydropower technology. New simplified parametric ratio for selection of turbines have been developed that should expedite preliminary selection study for hydropower projects.
W83-02489

WATERFLOW CONTROL,
International Water Power and Dam Construction, Vol 34, No 6, p 29, June, 1982.

Descriptors: *Hydraulic equipment, *Hydraulic valves, *Flow control, Hydroelectric plants, Hydroelectric power, Design criteria, Flow discharge.

The butterfly valve is one of the simplest and best valves for the control of water flow in hydropower installations. Its basic design is a circular disc rotating within a cylindrical bore. The development of better materials and improved design processes has extended the use of butterfly valves to new applications. Special coatings allow the valves to handle water with heavy sediment loads or high salt contents. Standard bearings are made of Franberlube (graphite-impregnated phosphorbronze), and valves for seawater applications of Ferrobestos (impregnated asbestos braiding). The blade is usually cast from spheroidal graphite iron. The seal is usually made from a neoprene-type material or a metal. The time involved in manufac-

turing a butterfly valve depends on whether the order calls for a standard model or a new design. Typical closure times are between 50 and 400 sec. Actuators are sized in accordance with required closure times. Typically, actuators are supplied by Rotork or Limitorque. Butterfly valves are one-fourth the size and weight of corresponding gate valves. They are simple to operate, with a minimal number of moving parts, and give reduced vibration of flutter. The streamlined body of the valve offers reduced pressure drop and good flow characteristics and their seals can be easily adjusted or replaced. Butterfly valves also save civil engineering costs compared with sluice valves. (Geiger-FRC)
W83-02534

FLOW MEASUREMENTS AT RACCOON MOUNTAIN,
Tennessee Valley Authority, Norris. Engineering Lab.
P. A. March.
International Water Power and Dam Construction, Vol 34, No 10, p 42-44, October, 1982. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Flow measurement, *Performance evaluation, *Hydraulic equipment, *Pump turbines, *Flow rates, *Pumped storage, Flowmeters, Aerial photography, Mathematical studies, Volumetric analysis, Storage reservoirs.

Flow measurements were made by three different techniques on unit number 1 of the 385 MW pump-turbines to establish efficiency curves for the Raccoon Mountain pumped-storage plant. In the Winter-Kennedy method, differential pressures in the unit 1 spiral case were measured with a servo-type water-over-mercury, differential manometer attached to two piezometer taps. Equations are given for tap calibration. In the acoustic flowmeter method, flow was measured by a four-path acoustic flowmeter with transducers mounted in a section of 3m-diameter conduit connecting the spiral case and the spherical valve. A volumetric method was used with the aid of aerial photogrammetry conducted before the reservoir was filled. Mathematical calculations were also required to compute flow rates. Other measurements needed for calculating unit efficiences included power output and input data, headwater and tailwater readings, net head efficiencies in the generating mode, and total head efficiencies in the pumping mode. Results showed that generating efficiencies based on the Winter-Kennedy method ranged from 0.876 to 0.916, while those calculated by the acoustic flowmeter ranged from 0.867 to 0.909. Flow rates measured using the Winter-Kennedy method averaged about 1.9% lower than those measured with the acoustic flowmeter, while flow rates measured with the volumetric method averaged about 1.7% higher than those measured by acoustic flowmeter. The overall uncertainties in the Winter-Kennedy and the acoustic flowmeter methods could be reduced by better calibration. Uncertainties in the volumetric method could be reduced with more specialized aerial techniques. (Geiger-FRC)
W83-02535

DEVELOPMENTS IN PUMP-TURBINES,
Ljubljana Univ. (Yugoslavia). Faculty of Engineering.
F. Schweiger, and J. Gregori.
International Water Power and Dam Construction, Vol 34, No 10, p 22-25, October, 1982. 7 Fig, 14 Ref.

Descriptors: *Turbines, *Pumped storage, Pump turbines, Design criteria, Hydroelectric plants, Hydraulic machinery, Powerplants, Graphical analysis, Statistical analysis, Specific speed, Flow coefficient, Pumping head, Energy coefficient.

Data on pump-turbine units collected from manufacturing plants are statistically analyzed to discern current trends in development. Although a wide range of specific speeds are covered, most are concentrated within 25-60. Graphs are presented for pump head vs. specific speed for 3 periods (before 1970, 1970-75, and after 1975). Specific speed has increased with constant pump head, showing that recently designed units can take higher loads. Further graphs and equations are given for specific speed vs. energy coefficient, flow coefficient, diameter ratios, and height ratio. A family of curves, called a type graph, for specific diameter vs. specific speed can be used for calculating basin runner diameters and to follow the systematic development of reversible units. (Cassar-FRC)
W83-02536

UNIQUE DESIGN FOR GUIJO DE GRANADILLA,
Hidroelectrica Espanola, Madrid.
J. deR. Sirougnet, P. M. Ruas, L. Becke, E. Randegger, and F. Mez.
International Water Power and Dam Construction, Vol 34, No 10, p 15-22, October, 1982. 13 Fig.

Descriptors: *Turbines, *Pumped storage, *Hydroelectric plants, Pump turbines, Dams, Irrigation, Hydraulic machinery, Hydraulic turbines, Powerplants, Multipurpose projects, Guijo de Granadilla Dam, Grabriel y Galan Dam, Valdeobispo Dam, *Spain.

A new pump-turbine of the bulb type was developed for the Guijo de Granadilla power facility, part of the 3-dam Gabriel y Galan-Valdeobispo hydroelectric and irrigation system on the Alagon River in Spain. A mixed pumped storage scheme was designed to allow power stations to operate independently of irrigation requirements. The electric generating system is operated over a few peak hours only on working days, whereas the irrigation demands vary widely during the year. Each of the 2 reversible 27 MW bulb sets at Guijo de Granadilla has a diagonal runner with adjustable blades and a fixed distributor. The design allows regulation of both turbine and pumping water discharge within a wide range by modifying the runner blade positions while maintaining high operational efficiency. Model development tests and design concepts are described in detail. Special features include electronic control of the runner blades, minimum power consumption during startup, design of radial bearings and double-sided tilting segment thrust bearings for two directions of rotation, provision for interim lubrication of bearings by high-level oil tanks in case of power failure, an axial sliding ring seal on the shaft, and a standstill seal. (Cassar-FRC)
W83-02538

USE OF ENERGY STORAGE BY INCREASING THE HEAD OF THE HYDROELECTRIC STATION-PUMPED STORAGE STATION,
L. A. Karol.
Hydrotechnical Construction, No 2, p 182-183, February, 1980. 2 Fig, 3 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 2, p 44-45, February, 1980.

Descriptors: *Pumped storage, *Pump turbines, *Hydroelectric plants, Turbines, Low head dams.

A pumped storage scheme is proposed for use in flatland regions, at sites where one of the banks is steep enough and has an area for creating an upper reservoir. Reversible mixed-flow pump turbines sets are available for heads of 100 m. This system directs water flow by manipulation of gates and draft-tube intakes. In a pump regime the water flows from the upper pool through an intake and is directed, not immediately to the scroll casing of the reversible unit, but to specially constructed pump part of the draft tube of the unit. (Cassar-FRC)
W83-02620

ASPECTS OF THE MACHINE FOUNDATION DESIGN AT DRAKENSBERG,
Electricity Supply Commission, Johannesburg (South Africa).
N. J. Terblanche.
Civil Engineer in South Africa, Vol 24, No 8, p 449, 451-454, August, 1982. 6 Fig, 13 Ref.

Descriptors: *Pumped storage, *Hydraulic machinery, *Underground structures, Strain, Stress, Drakensberg Pumped Storage Scheme, *South Africa, Foundations, Valves, Concrete technology, Rigid foundations, Pump turbines, Turbines.

The design and development of the foundations and surrounds of the pump-turbines, generator-motors, and spherical valves for the Drakensberg Pumped Storage Scheme, South Africa, are described. The underground structures were built in weak sandstones, siltstones, and mudstones, which restricted the sizes of the machine hall and other excavations. The bolts holding down the valves were designed to restrain the uplift and horizontal displacement caused by valve closure and the extension of the free straining penstock. In the pump-turbine foundations loads on the concrete were reduced and concrete strength maximized by embedding the spiral in carefully controlled stages under pressure. The generator-motors are contained in 12-sided concrete housings (barrels), which are connected with the underlying pump-turbine foundations and the overhead operating floor. A layer of thermal insulation 70 mm thick was placed inside the barrel to reduce the temperature difference of 50C, produced when cooling fans turn on at the maximum operating temperature. Instrumentation of one machine foundation permitted study of loads, stresses, strains, and temperature effects. (Cassar-FRC)
W83-02667

MAINTAINING DISTRIBUTION SYSTEM VALVES AND FIRE HYDRANTS,
Saint Louis County Water Co., University City, MO.
B. W. Franklin.
Journal of the American Water Works Association, Vol 74, No 11, p 576-579, November, 1982. 7 Ref.

Descriptors: *Valves, *Water distribution *Maintenance, *Hydrants, Pipes, Corrosion, Costs, Water loss, Leakage, Safety, Hydraulic valves, St. Louis, Missouri.

Experiences of the St. Louis County Water Company are presented, with emphasis on their ongoing maintenance program for valves and fire hydrants and on the procedures recommemded for maintenance by the industry. The system contains about 5280 km of pipeline ranging in size from 40 mm to 1050 mm pipe, and having 257,000 customer service connections, 21,400 fire hydrants, and about 40,000 valves. Various types of valves used include gate, butterfly, check, and ball. Some plug and cone valves are used for water flow control at plant and storage facilities. A good valve maintenance program begins with good installation. Ideally, valves should not be buried under excessive fill, should be set near intersecting streets or fire hydrants to facilitate location in the future, and should have marker stakes set on cross-country lines. Road improvements in the St. Louis County Water Co's service area require constant attention from the utility to ensure that valves are not lost. Corrosion is a problem in some areas and causes failure of bonnet and packing gland bolts. Gate valves that are about 50 years old or more are causing the most problems. Stem breakage in the 100 and 150 mm sizes is a common problem, as is difficulty with exposed gears and complete seating in larger sized valves. The American Water Works Association Standard C500-80 recommends that valves be exercised regularly through one complete operating cycle to prevent buildup of tuberculation and other deposits that would render the valve inoperable or would prevent a tight shutoff. The St. Louis County Water Co. has a program to operate all valves that are 400 mm or larger in main transmission lines and all branch lines yearly. Hydrants, like valves, should be maintained regularly to keep them serviceable. (Baker-FRC)
W83-02714

PROJECT STUDIES AND RESEARCH WORK CONCERNING BUTTERFLY VALVES AS USED IN WATER POWER STATIONS AND RETARDING BASINS (PLANUNGSKRITERIEN UND FORSCHUNG BEI DROSSELKLAPPEN FUR KRAFTWERKSANLAGEN UND RUCKHALTEBECKEN),

Technische Hochschule, Darmstadt (Germany, F.R.). Fachgebiet Hydraulische Maschien und Anlagen.
J. Osterwalder.
Wasserwirtschaft, Vol 71, No 12, p 368-372, December, 1981. 7 Fig, 1 Tab, 8 Ref. English summary.

Descriptors: *Butterfly valves, *Design criteria, *Powerplants, Hydroelectric powerplants, Valves, Retarding basins, Mechanical equipment.

Butterfly valves have to fulfill various requirements depending on the scope of application and specifications. Questions in connection with plant security, aspects of economy and hydraulic behavior are usually of great importance during the planning of a project. It is well known that corresponding answers can only be based on experimental investigations with models. In case of butterly valves for water power stations there are numerous useful publications. However, little information is available concerning butterfly valves with eccentrical shutters as they are often used for retarding basins. Recent research in this field is reviewed in this paper. Such model tests already enable a judgment of the situation to be made as accurately as possible. In many cases necessary constructive changes or modifications of the design can be recognized early enough to accomplish suitable corrections. One must keep in mind that the importance of such butterfly valves should not be judged according to their relatively low costs but rather in connection with the problems they can produce in case of failure. (Baker-FRC)
W83-02761

INSPECTION AND MAINTENANCE OF DAM DEWATERING FACILITIES,
Collins Engineers, Inc., Chicago, IL.
T. J. Collins.
Public Works, Vol 113, No 12, p 28-31, December, 1982. 4 Fig.

Descriptors: *Inspection, Reservoirs, *Outlets, Hydraulic gates, *Gates, *Dams, Corrosion, Diving, Dewatering, Water level, Maintenance, Photography.

Engineer-divers inspect equipment used for emergency dam dewatering structures prior to operating them. During the under water inspection, the diver can determine if the mechanisms can be safely operated. Debris removal and minor repairs and adjustments can also be done at this time. Since these mechanisms are often hidden under water and are rarely operated, there is a risk of losing an entire water supply if a gate cannot be reclosed after initial opening. Common problems are concrete distress in the tower; deterioration, damage, and corrosion to gate components; clogging with debris; poor alignment of the gate stem guides; and strong currents in submerged outlet control works. Inspections are documented by photography, drawings, and/or reports. (Cassar-FRC)
W83-02770

IMPROVEMENT OF THE POWER OUTPUT OF HYDROELECTRIC PLANTS (VERBESSERUNG DER LEISTUNGSFAHIGKEIT VON WASSERKRAFTWERKEN),
E. Kossler.
Wasserwirtschaft, Vol 72, No 5, p 213-214, May 1982. 3 Fig. (No English Summary).

Descriptors: *Hydroelectric plants, *Hydraulic loss, *Turbines, *Planning, *Water resources development, Austria, Rivers, Hydraulic machinery, Hydroelectric power, Mechanical equipment, Electrical equipment, Design flow, Drop height.

Methods of improving the output of hydroelectric power plants are discussed, with emphasis on small plants as a partial answer to the energy crisis. Although no reliable statistics exist on the number of small plants that have fallen into disuse over the past decades, studies in Austria have shown that careful planning could double or triple the power output potential of rivers. Large-scale measures, comprising assessment of the current situation and extensive planning, are problematic due to such considerations as water quality and the flooding of agricultural land, as well as the recent tendency to view rivers as nothing more than flood discharge channels. Cooperation between all interested groups is required to complete such projects. Measures specific to power plants include increasing the drop height, enlarging design flow, and reducing losses. The first of these is the most effective, since this influences output independent of water volume. This is especially true for low-pressure plants. It may be achieved by raising reservoir water level, deepening the underground channel, or merging drop stages. Enlargement of design flow is possible where the plant possesses its own weirs and the original turbines were built too small; in this case, new turbines are usually needed. Rivers are usually best exploited by means of a chain of weir power staions. The third possibility involves an examination of hydraulic, mechanical, and electrical losses. For the first type of loss, emphasis should lie with the turbines, where a bad hydraulic profile in the regulating devices and air wheel, rough surfaces in the high-speed region (due to rust, erosion, or cavitation), badly installed double regulation, the incorrect rate of revolution, and other problems may reduce efficiency. Problems in mechanical translation and in the electrical system (generator, transformer) are not as important as hydraulic failures. (Gish-FRC)
W83-02800

8D. Soil Mechanics

SEISMICITY INDUCED BY THE RESERVOIR LG-2 (LA SEISMICITE PROVOQUEE AU RESERVOIR LG-2)
Department of Energy, Mines and Resources, Ottawa (Ontario). Seismology and Geothermal Studies Div.
G. G. R. Buchbinder, F. M. Anglin, and R. McNicoll.
Canadian Journal of Earth Sciences, Vol 18, No 4, p 693-698, April, 1981. 6 Fig, 7 Ref.

Descriptors: *Rockfill dams, *Earth dams, *Reservoir stages, *Reservoirs, *Earthquakes, Storage reservoirs, Seismic waves, Dams, Earth pressure, Geologic faults, La Grande River, *Quebec, Canada.

The construction of a rock and earth-filled dam in the La Grande River valley, Quebec, has created a hydroelectric reservoir with a maximum depth of 145 m and a volume of 61.7 times 10 to the 9th power cu m. No seismicity in the Precambrian Shield region above the magnitude 0.1 was observed in the reservoir zone in the 27 months preceding the filling. Microearthquakes of magnitude less than one started under the reservoir when a water depth of 90 m was reached, after 30 days, and this activity continued for about three months. A second series of microearthquakes began in the same active zone when the rate of filling increased twofold. The seismically active area is confined to a zone 4 km x 7 km and no deeper than 5 km. The microearthquakes are considered to be the result of minor reactivation of old faults under the reservoir in response to the increased pore pressure. (Author's abstract)
W83-02575

LONG-TERM MONITORING OF EMBANKMENT DAMS IN BRITAIN,
A. D. M. Penman, and M. F. Kennard.
International Water Power and Dam Construction, Vol 34, No 11, p 19-26, 1982. 10 Fig, 23 Ref.

Descriptors: *Monitoring, *Dam failure, *Piezometers, *Pressure-measuring instruments, *Dam stability, Dam design, *Rock mechanics, *Pore pressure, Dams, Dam construction, Earth dams, Rockfill dams, Drainage, Reservoirs, Embankments, *Great Britain.

In 1930, following several dam failures, Parliament passed the Reservoirs (Safety Provisions) Act. The act requires British dams impounding more than 22,500 cu m to be entrusted to a reservoir engineer and be inspected at least every 10 years. The Reservoirs Act of 1975 has required the installation of monitoring instruments in British dams. Piezometers were installed in the Usk and Daer dams. They were of the two-tube design, and the addition of a Bishop filter allowed them to measure pore water suctions and pressures. A piezometer tubing of Nylon 11 coated with polyethylene was needed to prevent air bubbles in the piezometers, and a mercury manometer was adopted to measure pressure. The first results of monitoring indicated a need for filter drainage layers in the Usk dam. Such a drainage system was also installed at the Selset Dam, and one is now being installed at the Carsinton dam. In dams built between 1955 and 1965, instruments were installed to measure total stress. When the Balderhead dam showed signs of increased seepage and distress, a slurry trench cutoff on the core centerline was implemented. After failure of the dam, further pressure measurements were required to monitor dam stability. Adjustments of the rolled clay cores were also made at the Llyn Brianne and Scammonden dams, where additional total surveying targets allowed the recording of deflections in the downstream face of the cores of both dams during the first reservoir filling. Some specifications for clay cores, contact pressure considerations, and the operation of dam monitoring instruments are discussed. (Geiger-FRC)
W83-02628

MONITORING DAMS AND THEIR FOUNDATIONS,
A. Marazio.
International Water Power and Dam Construction, Vol 34, No 11, p 17, 1982.

Descriptors: *Dam construction, *Dam foundations, *Dam stability, *Rock mechanics, *Data collections, *International commissions, Design criteria, Dam design, Earth dams, Rockfill dams, Seismology, Concrete dams, Safety.

In 1982, ICOLD set up a committee to monitor dams and their foundations. The committee plans to update the criteria to establish an appropriate system for monitoring concrete and earthfill dams. Information will be collated and instrumentation methods available today and on the reliability of state-of-the-art techniques. The committee must also collect data from continuous recording systems such as seismic monitoring, and collate some case histories of old dams to serve as references. The safety of many old dams is questionable. Many made of earth and rockfill material, which calls for new safety measures. The acquisition of stress-strain patterns made it possible to understand the importance of dam foundation in relation to dam performance. Other instruments such as inverted plumb lines, rockmeters, and measuring and collecting systems have also been invented specifically for monitoring dam safety. Today dam operation may be simulated by numerical models. Existing dams can serve as prototypes for future dams. (Gieger-FRC)
W83-02629

NORWEGIAN PRACTICE IN INSTRUMENTING DAMS,
State Power System, Oslo (Norway).
For primary bibliographic entry see Field 8G.
W83-02630

TECHNOLOGY--WHAT IS IT FOR. TWO EXAMPLES FROM THE MORE THAN 2,000-YEAR HISTORY OF HYDRAULIC ENGINEERING IN CHINA (TECHNIK WOZU. ZWEI BEISPIELE AUS DER UBER 2000JAHRIGEN GESCHICHTE DES WASSERBAUES IN CHINA),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Hydromechanik und Wasserwirtschaft.
For primary bibliographic entry see Field 8A.
W83-02760

8E. Rock Mechanics and Geology

SURGE CHAMBER DESIGN FOR JUKLA,
Geoteam A/S, Oslo (Norway).
J. Bergh-Christensen.
International Water Power and Dam Construction, Vol 34, No 10, p 39-41, October, 1982. 8 Fig.

Descriptors: *Pumped storage, *Rock excavation, *Surge chambers, Rock bolts, Rock properties, Hydroelectric plants, Excavation, Jukla, Norway.

An unlined compressed air surge chamber for Norway's Jukla pumped storage plant was excavated in 1972-73. The 128 sq m cross section, 48 m long chamber has had no appreciable air losses at groundwater heads of 17 kg per sq cm or less and 20-200 normal liters per min at higher pressures. No reinforcement or sealing was necessary, except for grouted rock bolts in the roof. Preliminary tests in two 46 m and 67 m sections had shown that water at pressures up to 50 kg per sq cm produced losses corresponding to Lugeon values of 0.0002-0.0015. Air leakage at pressures up to 40 kg sq cm was 6-215 normal liters per min. (Cassar-FRC)
W83-02572

EMBANKMENT DAMS OF PAZ CASCADE OF HYDROPOWER STATIONS AND SOME CONCLUSIONS FROM THEIR OPERATIONAL EXPERIENCE,
D. M. Yashkul.
Hydrotechnical Construction, No 11, p 1140-1148, November, 1980. 3 Fig, 2 Tab, 5 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 11, p 24-29, November, 1980.

Descriptors: *Dam design, *Earth dams, *Drainage, Paz Cascade, *USSR, Embankments, Seepage, Rock fill, Vegetation, Slope stabilization.

The eight earthen dams comprising the Paz cascade on the Kola Peninsula, USSR, have maintained their integrity in the years since construction, 1951-1970. The embankments, varying from 18 to 2925 m crest length and from 13 to 22 m in height, were constructed of heterogeneous moraine soil placed by dry compaction. Crest deformations were significant. Seepage discharges were small, 1 liter per sec per 100 m length of crest in dams with a cut-off element and 2 liters per sec per 100 m length in dams with cores. Junctions between dam and concrete headworks using retaining walls had the worst antiseepage properties. Natural stone slabs used to protect dam slopes were subject to collapse on the downstream side and slumping on the upstream side. Snowing grasses to stabilize slopes was ineffective on the northern-facing slopes--only moss survived. Organic matter and topsoil lodging in the dam slopes and crest promoted infestations by woody shrubs, difficult to keep under control. In some dams the drainage water outlets caused water accumulation, seepage, and siltation. Maintenance for the group of dams required 35-60 man days per year. (Cassar-FRC)
W83-02593

CURRENT REQUIREMENTS IMPOSED ON THE CONTACT OF GRAVITY AND BUTTRESS DAMS WITH ROCK FOUNDATIONS,
Yu. A. Fishman.
Hydrotechnical Construction, No 11, p 1120-1125, November, 1980. 1 Fig, 1 Tab, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 12-16, November, 1980.

Descriptors: *Rock foundations, *Dam foundations, *Concrete dams, Gravity dams, Buttress dams, Dam stability, Dam failure, Dam design, Foundation failure, Foundation rocks, Drainage, Compressibility, Shear stress, Grouting, Deformation.

Design of dams to prevent failure at the concrete-rock foundation interface should consider not only the shear stresses but rotation (eccentric compression) in the contact section. The deformability of the rock foundation is an important factor in dam stability. Various engineering measures are evaluated. Rock under a dam base should be excavated if intensely weathered. Permeable and deformable rocks should not be automatically removed. Permeable rocks can enhance seepage drainage, and deformable rocks can favorably distribute stresses. It is sufficient to remove weak rock only under the downstream face, but it is not permissible to remove rocks from the upstream side, leaving weak rocks on the downstream side. Concrete in the contact zone should be high-grade in the downstream face and highly elastic over the entire base, especially near the upstream face. Grouting should be limited to about 1/3 of the dam width on the downstream face only. Construction of a reversed gradient of the base and upstream cutoff walls are practically useless. Dams anchored on the upstream side have increased protection against rotation; downstream anchoring is ineffective and is not recommended. Cutoff walls are not necessary for poorly permeable or nonpiping rock foundations. Often a small (to 10% of the height) upstream blanket can supplement or replace the cutoff wall. Drainage measures, such as curtain or drainage cavities, are effective and reliable means of reducing the uplift pressure on dam bases. Curtain drains should be located under the upstream face or, in some cases, the middle of the dam, rarely under the downstream face. (Cassar-FRC)
W83-02595

INSTRUMENTING AUSTRALIA'S CETHANA DAM,
Tasmania Hydro-Electric Commission, Hobart (Australia).
For primary bibliographic entry see Field 8A.
W83-02603

MODELING OF WATERCOURSE CLOSURE (MODELISATION DE FERMETURE DES COURS D'EAU),
Sherbrooke Univ. (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W83-02614

MONITORING DAMS AND THEIR FOUNDATIONS,
For primary bibliographic entry see Field 8D.
W83-02629

ROCK ENGINEERING INVESTIGATION AND DESIGN STUDIES FOR THE DRAKENSBERG PUMPED STORAGE SCHEME,
J. C. Sharp, and T. W. Mellors.
Civil Engineer in South Africa, Vol 24, No 8, p 399-400, 403, 405-409, 411-413,416, August, 1982. 17 Fig, 15 Ref.

Descriptors: *Rock excavation, *Underground structures, *Tunnels, Excavation, Drakensberg Pumped Storage Scheme, *South Africa, Pumped storage, Powerplants, Construction.

Unfavorable geological conditions required extensive exploratory studies for the underground works of the Drakensberg Pumped Storage Scheme, South Africa. About 5 km of tunnels and caverns were designed for construction in weak mudstones, siltstones, and sandstones. In addition to aerial and satellite photography, geological mapping, exploratory boreholes, geophysical surveying, magnetometer surveying, and mineralogic studies, full-scale trial prototypes of the machine hall and pressure tunnels were constructed. The power station was excavated in series of separate caverns to minimize the size of the roof spans. Rock reinforcement and shotcrete linings permanently support the cavern roofs. (Cassar-FRC)
W83-02644

SEISMIC SAFETY ANALYSIS OF LOWER CRYSTAL SPRINGS DAM: A CASE HISTORY,
Wahler Associates, Palo Alto, CA.
E. Solomon, and J. Bahr.
Bulletin of the Association of Engineering Geologists, Vol 19, No 4, p 411-426, November, 1982. 9 Fig, 6 Tab, 11 Ref.

Descriptors: *Dams, *Stability, *Earthquakes, Lower Crystal Springs Dam, *California, Seismic analysis, Safety, Flood control, Food prevention, Maintenance, Construction, Soil properties, Sandstone.

The stability of the Lower Crystal Springs Dam 32 km south of San Francisco is crucial to the protection of large downstream populations that have grown up since the dam was built in 1890. A seismic safety evaluation was conducted during 1976 and 1977. Field investigations provided geologic data regarding the width of the fault zone in the reservoir area, located the 1906 line of ground rupture, explored the foundation bedrock at the dam site, and evaluated the potential for faulting beneath the dam. Hazards to the dam from anticipated movement on the San Andreas fault were also evaluated. Design earthquakes were applied to a finite element model of the dam and its foundation to permit analysis of the structure's dynamic response to severe earthquake shaking. It was concluded that the dam would be able to withstand an earthquake of 8.5 magnitude, and that the physical properties of the foundation rock - an apparently hard but microscopically brecciated sandstone - contribute significantly to the satisfactory response of the dam. Fracturing of the foundation graywacke accounts for the capacity of the rock to absorb strain energy. The number and relatively small volumes of existing landslide masses should not be able to generate a wave overtopping the dam.
W83-02663

CONSTRUCTION OF THE MAIN CIVIL WORKS OF THE DRAKENSBERG PUMPED STORAGE SCHEME,
For primary bibliographic entry see Field 8A.
W83-02665

8F. Concrete

SAFETY MONITORING OF CONCRETE DAMS,
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
M. Fanelli, and G. Giuseppetti.
International Water Power and Dam Construction, Vol 34, No 11, p 31-33, 1982. 11 Ref.

Descriptors: *Safety, *Monitoring, *Concrete dams, *Theoretical analysis, *Mathematical models, *Stress, *Dam stability, Dam construction, Dam design, Model studies, Mathematical studies, Numerical analysis, Simulation analysis.

A rationale is developed for a deterministic method of checking the safety of concrete dams. It is assumed in such a system that measurements can be recorded continuously and that the vectorial field displacement on the upstream face of the dam is known. The new model could only be conceivably applied to dams for which safety checks had been laid down before the dam was built. The theoretical basis of the new checking method is described mathematically in terms of an ideal breakdown of the displacement field, the breakdown of system stress, the system of stresses assuming elastic behavior, and the determination of field stresses. Many of these aspects can be clarified, in whole or in part, by suitable numerical simulation studies on a theoretical case which can easily be set up if all the analytical instruments required for conducting them already exist. The possibilities offered by the deterministic model used would be improved if the measurement data were more scattered geometrically, more reliable, and collected at the proper frequency. (Geiger-FRC)
W83-02632

ROCK BALLS AT FOLSOM DAM, CALIFORNIA,
Water and Power Resources Service, Sacramento, CA.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 19, No 4, p 427-432, November, 1982. 9 Fig, 2 Ref.

Descriptors: *Dams, *Maintenance, *Rocks, Reservoirs, Construction, Cleanup, Earth dams, Concrete technology, Stilling basins, Folsom Dam, *California, Spillways.

Peculiar, nearly spherical balls composed of hard, igneous and metamorphic rock types were found in scattered debris in concrete-lined stilling basins of Folsom and several other dams in California. Ball formation is the result of rock abrasion under extremely turbulent flow conditions in an entrapment container and is associated with an undesirable erosion of container concrete lining. Proper design of basins, post-construction cleanup and protection from rock-throwing by visitors can eliminate formation of rock balls and reduce erosion of the lining. It is equally important to prevent rock falls on air-exposed slopes above basins and to remove loose debris which might be backwashed from river channel immediately downstream of stilling basins. At the Folsom Dam, on the American River in California, an earthfill structure with a 427 m long and 104 m high concrete gravity channel spillway section, rock balls caused intense erosion of the stilling-basin lining, with exposure of steel reinforcing bars. Repeated dewatering of the stilling basin for cleanup and repair was required. (Baker-FRC)
W83-02661

CONCRETE WATERWAY LININGS FOR THE DRAKENSBERG PUMPED STORAGE SCHEME,
Gibb, Hawkins and Partners, London (England).
M. T. Eastwood, and M. J. de Witt.
Civil Engineer in South Africa, Vol 24, No 8, p 435-437, 439-441, 443-445, 447, August, 1982. 8 Fig, 10 Ref.

Descriptors: *Linings, *Tunnel linings, *Underground structures, Concrete technology, Drakensberg Pumped Storage Scheme, *South Africa, Conduits, Water conveyance, Pressure conduits, Grouting, Pumped storage.

The Drakensberg Pumped Storage Scheme, South Africa, includes 8.5 km of croncrete-lined waterways and 1 km of steel-lined waterways and 1 km of steel-lined penstocks. Unreinforced concrete linings were chosen for the low pressure conduits. However, in the most degradable mudstones linings were backed with membranes. High pressure linings were prestressed by contact grouting. This process produced an elastic rock/concrete structure, which was suitable for the anticipated range of loading. Techniques used to achieve this high degree of stressing are described in detail. In areas of low overburden stress subject to hydrofracturing, steel linings were used. (Cassar-FRC)
W83-02668

8G. Materials

IMPROVING THE SPEED OF SHOTCRETE SETTING,
International Water Power and Dam Construction, Vol 34, No 4, p 35-37, April, 1982. 8 Fig.

Descriptors: *Sealants, *Construction materials, *Cements, Maintenance, Tunnel construction, Tunnels, Strength, *Shotcrete, Aggregates.

Shotcrete is a versatile material which may be used to coat tanks and pipes and repair tunnels and swimming pools. Shotcrete dries fast enough to render true early support. It can be used for repair in tidal zones directly in front of a rising tide. New accelerators for shotcrete contain no caustics or chlorides. With these new accelerators, initial set at 3% dosage was 1 minute 30 seconds and final set was 2 minutes 5 seconds. Strengths obtained with the new accelerator were over 2800 pounds/sq inch at 8 hr. The new noncaustic accelerator scored low in tests for skin and eye irritation. Factors affecting dry-process shotcrete are effective water content, prehydration, and experience of the personnel using it. Accelerated shotcrete is used where early support of a tunnel is needed, where a thick layer of shotcrete is required and where the sealing off of running water is required. (Geiger-FRC)
W83-02537

NORWEGIAN PRACTICE IN INSTRUMENTING DAMS,
State Power System, Oslo (Norway).
K. Y. Nilsen, E. DiBiagio, and A. Andresen.
International Water Power and Dam Construction, Vol 34, No 11, p 34-38, 1982. 7 Fig, 7 Ref.

Descriptors: *Dam construction, *Rockfill dams, *Earth dams, *Safety, *Measuring instruments, Dam stability, Concrete dams, Dams, Dam design, Embankments, Data acquisition, Leakage, Deformation.

The Norwegian Code of Practice for Dams requires that provisions be made for monitoring dam performance. However, except for measurements of seepage and deformation, the Code does not specify what aspects should be monitored. Relatively few earth and rockfill dams have been built in Norway in recent years. Dams in Norway are owned and operated by private, semi-private, or national companies. A department within the Norwegian Water resources and Electricity Board is charged with the supervision and regulation of dams. According to 1965 guidelines, a public warning system should be set up in each dam to monitor leakage and water level. Routine instrumentation should allow measurements of seepage and deformations of the dam during construction and measurements of porewater pressure in the core material to verify that the embankment is being constructed at a safe rate. Instruments at the Svatevann dam are described as an example of the latest monitoring devices available for rockfill and concrete dams. The measurement of seepage, surface deformations, internal deformations, total earth pressure, and pore-water pressure is discussed. On larger dam monitoring projects, data are recorded automatically by small microprocessor-based data loggers. Measurements are usually continuous throughout the first two or three cycles of filling and drawdown of the reservoir, and then are decreased considerably afterwards. Seepage data are recorded continuously in the vicinity of the weirhouse on strip-chart recorders, and data is transmitted to the nearest power station control room. (Geiger-FRC)
W83-02630

INSPECTING, PAINTING, AND MAINTAINING STEEL WATER TANKS,
Harper and Associates, Inc., Riverside, CA.
W. B. Harper.
Journal of the American Water Works Association, Vol 74, No 11, p 585-587, November, 1982.

Descriptors: *Water tanks, *Maintenance, Inspection, Painting, Coatings, Water storage, Storage tanks.

Water tanks require periodic inspection for signs of deteriorating paint coatings and regular maintenance of exterior and interior finishes. Dark exterior colors appear to degenerate faster than lighter colors and also cause more problems with interior coatings because of solar heat absorption. Methods of inspection are described, as are procedures for repainting and recoating tanks. A well-planned program of inspection, painting, and maintenance is within reach of every water organization, as professional assistance is available from a variety of sources. Awareness of the problem and initiation of a plan of remedial action will lead to many years of trouble free operation of steel water tanks. (Baker-FRC)
W83-02713

8H. Rapid Excavation

PARAMETERS OF CANALS CONSTRUCTED BY THE CRATER BLASTING METHOD,
D. M. Kushnarev.
Hydrotechnical Construction, No 9, p 910-915, September, 1980. 5 Fig, 3 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 20-24, September, 1980.

Descriptors: *Excavation, *Explosives, *Canal construction, Rapid excavation, Crater blasting, Blasting, Canal seepage, Seepage, Flow velocity, Erosion.

Field investigations of crater blasting of canals were carried out in sand, loam, and dense moraine clays under conditions of natural water content and in saturated soils. Blasting caused the fine clay particle content to increase in the upper horizons and decrease in the lower horizons. In noncohesive soils (sand) blasting did not change the physical and mechanical properties of the backfallen soil. In poorly cohesive and cohesive soils the backfallen material consisted of aggregates with high mechanical strength. The coefficients of friction immediately after blasting were 0.30-0.45 but decreased to 0.18-0.25 after siltation had decreased the roughness of the canal bed. Seepage and erosion were less in crater-blasted canals than in mechanically excavated canals. In a loam soil erosion was 4-5 times less in the blasted canal than in the dry canal. (Canal-FRC)
W83-02596

8I. Fisheries Engineering

COOLING SYSTEMS: CAN ENGINEERS SAVE THE FISH,
Burns and Roe, Inc., Oradell, NJ. Hydraulic Engineering Dept.
R. T. Richards.
Consulting Engineer (St. Joseph), Vol 59, No 5, p 58-64, November, 1982. 5 Fig.

Descriptors: *Cooling water, *Thermal discharges, *Fish conservation, Water cooling, Cooling towers, Cooling ponds, Thermal plumes, Thermal pollution, Thermal powerplants, Thermal water, Powerplants, Aquatic environment, Intakes, Screens, Entrainment, Protection, Fish barriers, Fish eggs, Fish guiding, Fish handling facilities, Fish passages, Water quality control.

The adverse effects of powerplant cooling systems on the aquatic environment can be mitigated by several engineering measures. Heated water leaving the cooling system may be recycled, routed to captive ponds or spray ponds for partial cooling prior to discharge, or treated by a combination of systems. Fish may be protected by recovery from the intake screens and return to a safe section of the waterway, by diversion using angled screens and louvers, by deterrents such as air bubble curtains and noise generators, by exclusion (very fine screens or a radial well system), by choosing an intake site away from areas of the screen faces, by using velocity caps, and by using cylindrical pipe intakes. Some typical discharge methods are low velocity (2 fps) canal discharge, low velocity diffuser discharge, single port low velocity (5-7 fps) discharge, single port high velocity (12-15 fps) discharge, and multiport (sometimes 50 ports) discharge. Discharge temperatures may be reduced by increasing the amount of water passing through the condenser or adding cool water to the hot discharge. Engineers must also consider the potential effects of a powerplant shutdown (which suddenly eliminates heated discharge from an adapted environment), minerals discharged by blowdown, construction of facilities, and dredging. (Cassar-FRC)
W83-02551

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH COORDINATION AND PLANNING IN THE COLORADO RIVER-GREAT BASIN REGION,
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-194126, Price codes: A05 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Completion Report, Colorado State University,

Fort Collins, February 1983. 92 p, 2 Fig, 2 Tab, 3 Append. B-146-COLO(1), B-155-COLO(1), 14-31-0001-6064(1), 14-34-0001-7144(1).

Descriptors: *Planning, *Project planning, *Regional planning, *River basin development, Water resources development, *Colorado River-Great Basin region, *Water Research Institutes.

Summaries are presented of regional research planning and implementation activities carried on by the Consortium of Colorado River-Great Basin Water Institutes and Centers (CWIC) beginning in FY1973. At that time a regional research program was initiated in response to Congressional concerns over the need for research concerning water problems common to two or more states. Administrative funds were allocated to one Institute in each region for use in initiating this new program. The Colorado Institute was selected as the administrative manager for the Colorado River-Great Basin Region. Seven states are within that region, including Colorado, Wyoming, New Mexico, Utah, Nevada, Arizona, and California. The CWIC funding was allocated in Projects X-138, B-146-COLO, and B-155-COLO. Subcontracts were executed with each of the basin Institutes covering their participation. Active collaboration in identifying regional water problems and formulating the appropriate research approach to solving those of highest priority was established with the Pacific Southwest Interagency Committee (PSIAC). Consequently, the CWIC regional research program was intergrated into the PSIAC at the outset, and became a regular element of their activities. CWIC directors met quarterly with PSIAC at its regular meetings, giving progress reports and getting recommendations on specific research needs as well as priorities. This led to a very effective regional research program.
W83-02744

10. SCIENTIFIC AND TECHNICAL INFORMATION

PRECONCENTRATION METHODS FOR THE ANALYSIS OF WATER BY X-RAY SPECTROMETRIC TECHNIQUES,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W83-02654

10F. Preparation Of Reviews

DISTRIBUTION OF ACTINOMYCETES IN NATURAL WATERS (A SURVEY),
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W83-02624

THE ISOLATION OF BACTERIOPHAGES FROM THE ENVIRONMENT,
Searle and Co. Ltd., High Wycombe (England). Searle Research and Development.
For primary bibliographic entry see Field 5A.
W83-02708

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